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CLINICAL REPORTS

RELATIONSHIP OF THE PYLORIC SPHINCTER TO PEPTIC ULCER

IT is a remarkable fact that the treatment of peptic ulcer has attained its present efficiency through methods which are essentially empirical. Therapeutic progress and results have far exceeded the advance made in etiologic studies, a state of affairs that is not unusual in surgery. There is ample evidence to support the conclusions that some peptic ulcers heal spontaneously, that others are cured by medical measures, and that the results of proper surgical treatment are among the best obtained by any surgical procedure.

We are accustomed to look upon a surgical lesion as the cause of disturbed function which we endeavor to restore to normal by removing the offending lesion. Operations primarily done for the correction of abnormal function have not always been kindly received. Yet the dominant control which pathology has maintained over the craft of surgery must soon recognize the primary etiologic importance of derangement of function. Progress in the understanding of peptic ulcer has been retarded by a blind belief in orthodox teaching, a willingness to be satisfied with good-enough results; by the digressing and often acrimonious disputes between the advocates of medical

and surgical therapy, and by false attempts to treat the symptoms rather than the disease.

The treatment of peptic ulcer exclusively by medical means is uncertain and hazardous. Direct inspection affords the only certainty of the existence and the state of an ulcer. The accidents of hemorrhage and perforation cannot be foreseen or prevented.

While the results of surgical treatment have been a lasting benefit to many patients, the surgical failures have received undue publicity. Postoperative results are easily determined but the morbidity and mortality of medical treatment remain unknown and we have no desire to compute them.

Numerous theories have been exploited in the search for the cause of peptic ulcer, but until recently little has been done to disturb the status of gastro-enterostomy in the treatment of this condition. Peptic ulcer now enjoys earlier recognition and earlier treatment than formerly, but gastro-enterostomy when done in the early stage has not been attended by the satisfying results which followed its use for older lesions complicated by pyloric obstruction. It also seems that the immediate good results of gastro-enterostomy are not always maintained as the postoperative period lengthens.

While the symptoms of peptic ulcer are highly pathognomonic, every experienced surgeon has encountered many instances where the clinical history, laboratory tests, and *x*-ray reports have clearly indicated an ulcer which did not materialize when the stomach and duodenum were carefully inspected by sight and touch. Typical symptoms in the absence of ulcer are not uncommon. The mimicry of ulcer by disease of the appendix or of the gall-bladder suggests that the characteristic disturbance of gastric function is not dependent on ulcer alone, and that this functional derangement may actually precede and later cause the appearance of ulcer. While peptic ulcers are characteristically chronic there are a surprising number of acute lesions which heal spontaneously. It does not seem, therefore, that the cause of chronicity lies in the ulcer itself. Furthermore, in many instances, there seems to be an inherent tendency for the ulcer

to recur after excision, after gastro-enterostomy, and even after resection of the stomach. These recurrences can no longer be ascribed to faulty technic. We attempt to condone our ignorance by speaking of patients with an ulcer diathesis.

From the above facts it would seem that we have good reason to regard peptic ulcer as a sequel of persistent dysfunction of the stomach. This theory is further supported by Mann's experiments with surgical duodenal drainage and by Morton's production of jejunal and gastrojejunal ulcers. It cannot be denied that hydrochloric acid is an important factor in the causation of ulcer. How this normal secretion of the stomach may become a harmful agent can be partially explained by the surgical physiology of the stomach.

The main secretory products of the stomach are pepsin and hydrochloric acid which attain their identity only after leaving the gastric glands. Newly formed hydrochloric acid has a concentration of about 0.5 per cent. Since this concentration of acid is injurious to living cells and inhibitory to gastric digestion, it is normally reduced to an optimal strength of 0.2 per cent. This reduction is accomplished by ingestion of food and liquids, by the secretion of the stomach of other diluents, especially during the intergastric phase of digestion, by the possible ability of the stomach to regulate its own acidity, but mainly by the established fact of regurgitation of alkaline duodenal secretion back through the pylorus and into the stomach. In the regulation of gastric acidity the pyloric sphincter plays a double rôle in its control of duodenal regurgitation and the outflow of gastric contents. Normally, the function of the sphincter is nicely co-ordinated with the activity of the stomach through nervous control. When this co-ordination is disturbed it is manifested clinically by pylorospasm or achalasia. The disturbance is usually temporary and may be seen following an indiscretion in diet, as the result of mental stress and strain, and frequently after operation, especially when the peritoneum has been opened. Intraperitoneal disease, such as appendicitis, cholecystitis, and pelvic disorders, is particularly disturbing to the pyloric sphincter and exerts a more prolonged effect.

Clinical studies have shown that in certain individuals the pyloric sphincter is unusually irritable and may exhibit inco-ordination such as spasm or achalasia over long periods of time. Patients with peptic ulcer usually have pylorospasm or achalasia and, as Morton has shown in these cases, there is free hydrochloric acid in the first portion of the duodenum where under normal conditions it is never found; while Alvarez has demonstrated hypertrophy of the pyloric sphincter in cases of gastric ulcer but not in duodenal ulcer.

Although the normal activity of the pyloric sphincter is in accord with gastric function, a disturbance of its mechanism may cause partial retention of the contents of the stomach. This is exemplified in marked degree by infantile pyloric stenosis. Lesser grades of retention as the result of achalasia and pylorospasm occur in peptic ulcer. Actual obstruction with reversed peristalsis and vomiting only ensues when there is cicatricial contraction of the pylorus. Compensatory hyperperistalsis is usually sufficient to overcome the resistance of the pyloric sphincter which exists in cases of ulcer, so that emptying of the stomach, although delayed, is eventually accomplished. While pylorospasm and achalasia cannot withstand the push of gastric peristalsis, they act as a marked hindrance to the weaker force of duodenal regurgitation. Abnormal function or inco-ordination of the pyloric sphincter must hold an important place in our understanding of the cause, symptoms, and treatment of peptic ulcer and in the explanation of therapeutic failures. The results of pyloric dysfunction are partial gastric retention with compensatory hyperperistalsis, disturbance of the acid-alkali balance at the pylorus, hyperchlorhydria from interference with duodenal regurgitation, and the ejection into the duodenum of hyperacid gastric contents. There is reason to believe that peptic ulcer forms when this abnormal state persists and that repair of the ulcer occurs when the above-mentioned conditions return to normal, either of their own accord as in the spontaneous remissions in the natural history of ulcer or as the result of mechanical intervention.

Gastro-enterostomy has hitherto been the most successful

treatment for peptic ulcer. By making a new stoma in the stomach the ill effects of pyloric obstruction are largely obviated, and gastric retention and hyperacidity are controlled by freer drainage and regurgitation through the stoma. But the anastomosis may fail to accomplish these essentials when the current in the proximal loop sweeps past the stoma without entering the stomach, and a marginal or jejunal ulcer or reactivation of the old ulcer may occur. The formidable nature of the lesions which mark the failure of gastro-enterostomy has been the chief objection to the operation. More radical measures, such as resection of the stomach, have not only added little to the results of gastro-enterostomy but carry a higher mortality and a sizeable percentage of failures.

Simplicity and conservatism rather than increasingly radical and deforming operations should be the objective in the surgical management of ulcer. This is especially true in view of the fact that some ulcers heal spontaneously and that nearly all uncomplicated ulcers show a tendency to heal during remission of symptoms only to become reactivated when the pyloric syndrome recurs.

On the basis of the theory which we have advocated in previous communications that peptic ulcer is a sequel of dysfunction of the pyloric sphincter we have, in the last two years, carried out an operation designed partially or completely to abolish the function of the sphincter. On first thought it might appear that simple cross-section of the sphincter after the method of Rammstedt or by the pyloroplasty of Heineke-Mikulicz would suffice to cripple the sphincter permanently. But in our experience and in the reports of others, such procedures accomplish only temporary interruption of function until the interposition of scar tissue unites the divided ends of the sphincter after which it carries on its function as before. Complete denervation of the sphincter cannot abolish its action because the intestinal musculature can contract and relax independently of nerve attachments. Removal of the anterior half of the pyloric sphincter, after the method described in a previous paper and herein illustrated, seems to insure prolonged abolition of

pyloric function. This operation is carried out simply and quickly without extensive exposure or dissection. Its perform-

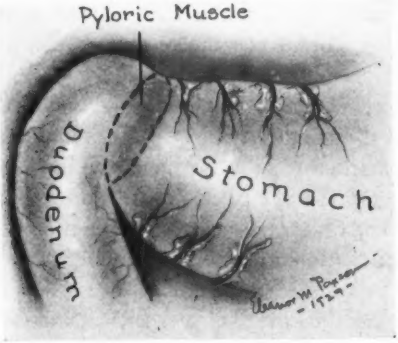

Fig. 368.—Removal of portion of pyloric muscle. Step 1. Lines of excision.

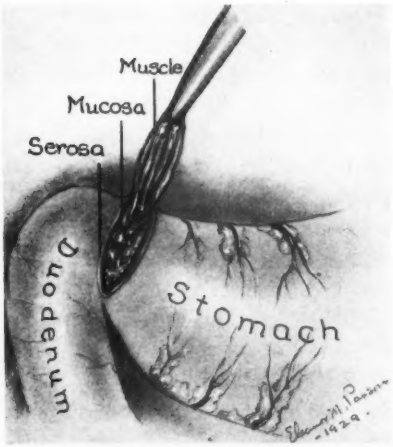

Fig. 369.—Removal of portion of pyloric muscle. Step 2. Removal of muscle.

ance consumes less than half the time of gastro-enterostomy; there is little chance for technical error, and the finished operation does not disturb the normal anatomic relationships of the parts involved.

We have performed this operation with gratifying results in chronic duodenal and gastric ulcer, in acute perforated duodenal ulcer, in gastrojejunal ulcer, and in combination with circular resection of the stomach for ulcer. We have also removed

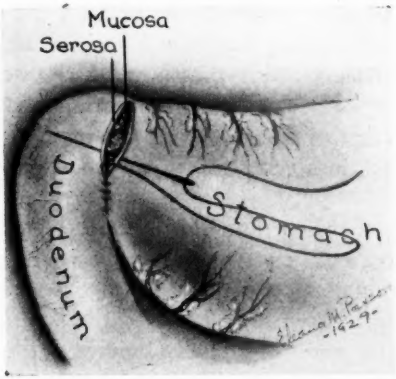

Fig. 370.—Removal of portion of pyloric muscle. Step 3. Closure of serosa.

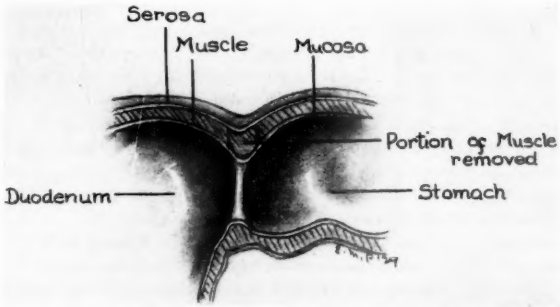

Fig. 371.—Section through stomach and duodenum showing portion of pyloric muscle removed.

the anterior half of the pyloric sphincter for pylorospasm associated with disease of the gall-bladder and appendix. The results up to the present time have been very satisfactory. The patients experience immediate relief of symptoms; and while postoperative gastric analyses have not shown absence of free hydrochloric

acid, the curves have been within normal limits. Fluoroscopic studies of the stomach after operation have shown normal peristalsis with slightly shortened emptying time.

Recognized contraindications to the operation have to do with local conditions about the ulcer which make it technically difficult or impossible to remove the anterior half of the sphincter. Such conditions are extensive fibrosis or acute infiltrating inflammatory edema about the ulcer which has invaded the region of the pylorus. Although the operation does not necessitate mobilization of the duodenum, the presence of the above-mentioned conditions makes it unsafe to place the necessary sutures.

The results of the operation, its simplicity and the avoidance of marginal ulcer seem to justify its continued use (Figs. 368–371).

The following abstracts of cases will serve to illustrate some conditions for which we have removed the anterior half of the pyloric sphincter and the results obtained at varying periods after operation.

ACUTE PERFORATED DUODENAL ULCER

A. D., male, age twenty-two years, was admitted to the Lankenau Hospital as an emergency case September 24, 1928. About three hours before admission he had had a sudden severe stabbing pain in the epigastrium. Vomiting was induced, but did not give relief. There had been no previous digestive symptoms until one week before admission when he developed a burning pain in the epigastrium which came on about fifteen to thirty minutes after meals and was relieved by food. On further questioning, he admitted that he had had periods of indigestion at the age of fourteen and fifteen years, each time lasting about three months.

Examination.—Blood-pressure was 128 systolic and 84 diastolic. The abdomen presented a board-like rigidity, which the patient protected with his hands. There was exquisite tenderness in the epigastrium with signs of hyperperistalsis over the entire abdomen. Temperature, 99.1° F.; pulse, 100; respirations, 30.

Emergency Operation.—September 24, 1928. Dr. Deaver. Spinocain. Upper right rectus incision. The peritoneal cavity contained foul-smelling fluid, and there was a perforation the size of a pea in the first portion of the duodenum. The perforation was closed by suture and by a tag of omentum. The anterior half of the pyloric sphincter was removed.

Drainage.—One large piece of rubber dam under the liver; a glass tube in the pelvis through a suprapubic stab wound. A McBurney incision was made and the appendix removed.

The patient made an uneventful recovery and was discharged from the hospital, October 11, 1928. He was examined in the follow-up service, March 28, 1928 and reported complete relief of symptoms.

Fractional test-meal readings at this time were:

	1	2	3	4	5	6	7	8
Free HCl	40	38	40	45	63	53	23	60
Total acidity	52	48	58	58	83	120	80	

Fasting contents, 16 c.c.; free HCl, 22; total acidity, 32.

A fluoroscopic examination demonstrated some deformity in the first portion of the duodenum with slight increase of gastric peristalsis.

DUODENAL ULCER; CHRONIC CHOLECYSTITIS; CHRONIC APPENDICITIS

B. B., male, age thirty years, was admitted to the Lankenau Hospital, May 7, 1928, because of stomach trouble. The patient had complained for the past two years of recurring attacks of burning epigastric pain, occurring about two hours after meals and promptly relieved by soda bicarbonate. During the past month the pain has been more severe and constant. Appetite normal. Bowels move regularly. He also complained of an inguinal hernia on the right side. The past medical history was irrelevant.

Examination.—Blood-pressure 114 systolic, and 60 diastolic. A ptosis of the right kidney, and a right indirect hernia were present. The remainder of the abdomen was apparently negative.

Red blood-cells numbered 3,200,000; white blood-cells 6000, and hemoglobin 85 per cent.

Fractional test-meal readings were as follows:

	1	2	3	4	5	6	7	8
Free HCl	12	12	10	10	9	9	11	29
Total acidity	71	60	59	52	69	49	60	58

Fasting contents of stomach, 6 c.c., showed free HCl of 14 and a total acidity of 92.

A fluoroscopic examination of the stomach and duodenum was negative, except for a small persistent deformity on the anterior wall of the first portion of the duodenum.

The patient was put on a dietary regimen under which there was some improvement in the symptoms, but he still continued to have the burning pain and much belching of gas.

Operation.—May 19, 1928. Dr. Deaver. Spinal anesthesia. Upper right rectus incision. A duodenal ulcer with contraction was found on the first portion of the duodenum. The anterior half of the pyloric sphincter was removed. The gall-bladder showed evidence of chronic infection and was removed. Appendectomy. Drainage: One rubber tube in subhepatic fossa. The patient made an uneventful convalescence.

July 27, 1928, the patient was seen in the follow-up service and reported relief from symptoms and a gain of 10 pounds in weight. Again on February 18, 1929. Continued entirely free from former complaints. Weight, 163 pounds.

Fractional test-meal at this time showed:

	1	2	3	4	5	6	7	8
Free HCl	75	88	92	80	54	70	55	68
Total acidity	90	100	108	95	103	94	60	79

Fasting contents, 2½ c.c.; free HCl, 28; total acidity, 40.

BLEEDING GASTRIC ULCER

A. M., male, age thirty-two years, was admitted to the Lankenau Hospital, January 30, 1929. Six months before admission he began to experience a griping pain which radiated upward under the sternum and occurred about three hours after meals. The pain was promptly relieved by food. It usually came on after the morning and noonday meals, and recurred daily. About five days before admission he began to vomit dark-red blood and suffered from a dull headache and later a wild delirium which lasted for twenty-four hours. He is still very nervous and occasionally has delirium. The previous digestive history was negative.

Examination.—The blood-pressure was 128 systolic and 80 diastolic. Weight was 136 pounds. Temperature 99° F.; pulse 108; respirations 28.

There was a soft, blowing, systolic murmur over the entire precordium. There was spasm of the upper portion of both rectus muscles and slight tenderness over McBurney's point. Red blood-cells numbered 1,520,000. Hemoglobin 55 per cent. An *x*-ray of the chest showed slight dilatation of the arch of the aorta with increased pulsation. The left ventricle was hypertrophied. There was no evidence of aneurysm.

The patient was delirious and required restraint. He was given enteroclysis of glucose, saline, and whisky for four days.

Operation.—February 4, 1928. Dr. Deaver. Gas anesthesia. Upper right rectus incision revealed an ulcer located slightly posterior on the lesser curvature of the stomach. A sleeve resection of the stomach including the ulcer was made, and the proximal and distal portions were reunited by suture. The anterior half of the pyloric sphincter was removed.

Microscopic examination of the resected portion of the stomach showed chronic benign gastric ulcer.

The patient made an uneventful convalescence and was discharged from the hospital, February 23, 1928. He came to the follow-up service, April 10, 1928, weighing 140 pounds, and said that he was perfectly well. A fluoroscopic examination of the stomach, at this time, was negative except for slight distortion of the pyloric region. When seen again February 8, 1929, he weighed 147 pounds, and was entirely without complaints.

Fractional test-meal at that time was:

	1	2	3	4	5	6	7	8
Free HCl	20	12	15	40	40	49	55	60
Total acidity	40	43	45	60	58	68	75	75

Fasting contents, 11 c.c.; free HCl, 16; total acidity, 28.

Fluoroscopic examination of the stomach and duodenum was negative, except for postoperative deformity. The tone and peristalsis of the stomach were good. There was no obstruction.

HERNIA THROUGH THE FORAMEN OF WINSLOW

C. G., male, white, age twenty-seven years, was admitted to the Lankenau Hospital, December 9, 1923, because of severe pain in the upper abdomen. About twenty-four hours before admission he suffered a sudden onset of severe pain in the epigastrium which was followed by vomiting at frequent intervals. The pain increased in severity and was more or less constant. In his previous history he had had attacks of burning pain in the epigastrium, shortly after meals, over a period of several years. These attacks were not accompanied by nausea or vomiting.

Examination.—The patient was pale and appeared to be in a condition of shock. Temperature was 97.2° F., pulse 118, respirations 24.

The abdomen was distended and presented generalized rigidity which was almost board-like. Tenderness was more marked in the epigastrium than elsewhere. Peristalsis was sluggish on the left side and was loud and prolonged.

The patient was given morphin for relief of pain. This was followed by a decrease of voluntary rigidity of the abdomen, and it was then noted that the rigidity was most marked over the upper right rectus muscle.

Operation.—December 9, 1923. Dr. Deaver. Ether. Upper right rectus incision. The peritoneal cavity contained bloody, serous fluid, and the bowel was seen to be discolored. A large part of the upper small intestine was distended and dark in appearance. The gall-bladder was distended and appeared to be diseased. It was attached by strong adhesions to the omentum and duodenum. About 2 feet of the small intestine, above the transverse colon was protruding through the foramen of Winslow. Reduction of the herniated bowel was accomplished with difficulty. The foramen was closed by a continuous chromic catgut suture. The state of the bowel seemed satisfactory for its return to the abdominal cavity.

The patient had a rather stormy convalescence. The temperature rose to 101° F., and he was irrational for several days. Recovery progressed satisfactorily and he was discharged from the hospital, January 16, 1924.

The patient was seen in the follow-up service, April 4, 1924, December 9, 1924, December 11, 1925, and finally, December 17, 1926. He has remained entirely well and has no complaint.

Hernia through the foramen of Winslow is a very rare condition and when found is usually associated with some congenital anomaly of the intestinal tract, such as faulty rotation of the viscera or the presence of a common mesentery for the entire intestinal tract. The foramen of Winslow is usually small and is often occluded by adhesions which act to preclude the formation of a hernia through it. Reduction of a hernia through

this foramen is often attended by supreme difficulty because of the danger incident to injuring the neck of the hernia which has within its immediate vicinity such important structures as the portal vein, the hepatic artery, the common bile-duct, the inferior vena cava, and the first portion of the duodenum. Usually

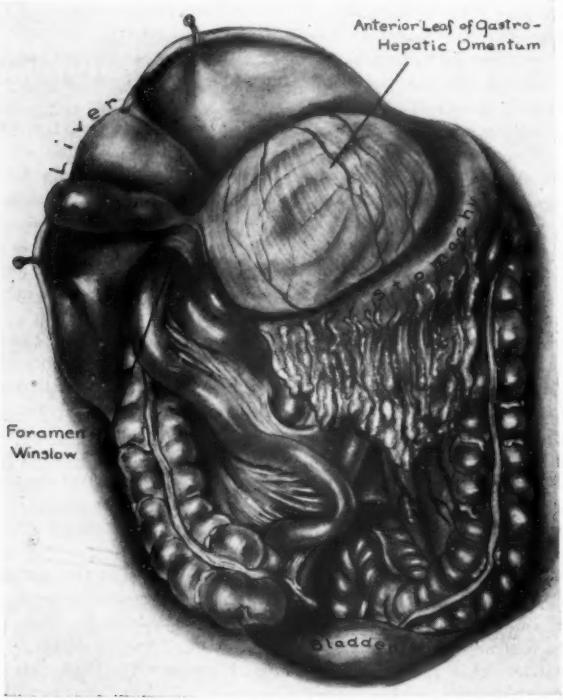

Fig. 372.—Hernia through the foramen of Winslow.

the only procedure which can be safely carried out is the making of a jejunostomy and allowing the herniated portion of the intestine to remain in the lesser peritoneal cavity.

Needless to say, the mortality in the reported operations for this condition is high.

RIGHT PARADUODENAL HERNIA

J. M. (Case No. 2242), male, age twenty-five years, was admitted to St. Joseph's Hospital, September 6, 1927. Two days before admission the patient was awakened at night, by severe pain in the right upper quadrant of the abdomen followed by vomiting. After taking a bottle of citrate of magnesia he vomited again and had three bowel movements. The pain continued through to the next day when he consulted his physician who told him he had appendicitis. The patient states that he had several previous similar attacks.

Examination.—The patient was a well-nourished, rather stout young man. Blood-pressure 130 systolic, 65 diastolic. Temperature, pulse, and respiration were normal. The patient was not suffering acute pain at the time of the examination, but tenderness could be elicited over the entire right side of the abdomen. The abdomen was full and rounded, but no palpable masses could be made out.

Urinalysis was normal. Red blood-cells numbered 5,000,000; white blood-cells 5000, and hemoglobin was 95 per cent. It was thought that the patient had a subsiding appendicitis and operation was advised.

Operation.—September 7, 1927. Dr. Burden. Low right rectus incision. On opening the peritoneal cavity the small intestine seemed to be inclosed in a separate translucent membrane. The appendix was located in the right iliac fossa, and was removed. After enlarging the incision the hand could be swept over the peritoneal cavity, and it was found that the entire small intestine with the exception of about 30 cm. of the initial jejunum and about 60 cm. of the terminal ileum was encased in a huge hernial sac which almost filled the peritoneal cavity. This sac seemed to be free along its left border so that it could be turned somewhat toward the right. This maneuver disclosed the opening of the sac, about 8 cm. in diameter, which looked upward and to the left. Issuing from the neck of the sac were two loops of bowel, the upper loop being composed of jejunum which was distended and showed marked thickening of its walls, the lower loop being the terminal ileum. The contents of the sac were reduced by gentle traction on the bowel. Examination of the neck of the sac revealed that its anterior margin contained the superior mesenteric artery, its posterior wall was formed by the lumbar vertebræ. The sac was excised close to its neck, care being taken to avoid injury to the vessels; the opening was closed by suture. The patient made an uneventful recovery and was discharged from the hospital on the thirteenth day. He was seen at intervals for about a year and had remained entirely free of symptoms.

This case is an instance of right paraduodenal hernia. The condition is infrequent and has usually been discovered only at autopsy. In 1923 Nagel reported 28 cases collected from the literature to which he added one from the Mayo Clinic. In 12 of the reported cases operation had been performed, with only two patients surviving. The remaining cases were discovered at autopsy or in the dissecting room. According to Moynihan

right paraduodenal hernia originates in a fossa in the mesentery of the upper part of the mesojejunum, which was first discovered by Waldeyer and is sometimes spoken of as the mesentericoparietal fossa. The condition is rarely diagnosed during life and is usually an accidental finding. In the histories of the cases reported the symptoms described may be classed as digestive troubles, chronic intestinal obstruction, and acute intestinal obstruction. The only feature in the physical examination which might be suggestive of a paraduodenal hernia is the finding of a palpable, definite, resonant mass. However, the examiner rarely has this condition in mind and consequently the diagnosis during life or before operation has never been made so far as we have been able to determine.

HEMATOMA OF RECTUS MUSCLE

J. W., colored, age twenty-two years, was admitted to the Philadelphia General Hospital, May 10, 1929 complaining of a painful lump in right epigastrium, and a cough of two months' duration.

The patient states that six weeks ago he had a "cold" and a heavy cough. During a paroxysm of coughing, one day, he became unconscious and was admitted to the hospital for treatment where he remained for about one week. Following his discharge from the hospital his cough persisted and was frequently associated with epigastric pain. There was no history of hemoptysis. About three weeks before his last admission he had a severe attack of coughing, during which he experienced severe pain in the epigastrium, and at that time noted a painful swelling just below the right costal margin. The pain in this area lasted for about thirty-six hours. There were no gastro-intestinal complaints and no fever. The patient stated that he had typhoid fever six years ago, which confined him to bed for three weeks and was complicated by phlebitis of the left leg. He denies a history of chancre.

Examination.—The patient is a well-developed young adult. The pulse, temperature, and respirations were normal. Examinations of the chest and heart were normal. Just below the right costal margin was a firm, ill-defined swelling about 7 cm. in diameter. It was slightly tender to pressure. It did not move with respiration and was apparently not attached to the costal margin. There was no discoloration of the overlying skin. The urinalysis was negative. The red blood-cells numbered 5,160,000; white blood-cells 9200, and hemoglobin was 80 per cent. The differential count was normal. Blood Wassermann was negative. *x*-Ray examination of the chest was normal.

A diagnosis was made of hematoma of the rectus muscle.

Operation.—May 16, 1929. Dr. Burden. Local and gas anesthesia. Incision over the tumor revealed discoloration of the anterior sheath of the rectus muscle. The sheath was incised and revealed a large blood-clot, evacuation of

which revealed a cavity extending through the muscle down to the posterior sheath of the rectus muscle. Examination of this cavity seemed to show that in addition to the rupture of a blood-vessel, probably a terminal branch of the superior epigastric artery, there had also been a rupture of a number of fibers of the rectus muscle. The sheath of the muscle and the skin were closed around a small drain of iodoform gauze which was inserted into the cavity.

Hematoma of the rectus muscle is not a common occurrence and is usually found lower down than the epigastric region. This case was interesting from the standpoint of differential diagnosis as to the cause and nature of the tumor. The swelling might have been due to a localized inflammation or to an epigastric hernia.

SUPPURATIVE THYROIDITIS

Patient E. K., colored, female, age fifty-six years, was admitted to the Philadelphia General Hospital, July 23, 1928, because of a draining sinus in the left anterior portion of the neck, which followed an operation on June 5, 1928 by Dr. Seelaus at this hospital. The patient was first admitted to the Philadelphia General Hospital on March 24, 1928, because of a tender swelling in the anterior portion of the neck. At that time she stated that she had had an enlargement, in this area, about the size of an egg, for the past twenty years, and that nine days before admission she had attended a clinic at another hospital where her neck had been examined. She thought that the trauma incident to palpating and squeezing of her neck had produced the painful swelling. Her voice was hoarse and she was not able to talk above a whisper. There was no difficulty in swallowing. She also complained of weakness and roaring in the head. There were no cardiac or respiratory complaints.

Examination at that time showed a colored woman who appeared weak and toxic. There was a marked enlargement of the anterior portion of the neck, especially on the left side where there was evidence of fluctuation over an area just to the left of the midline. Although the mass moved slightly in swallowing it seemed fairly well attached to surrounding structures. The overlying skin was inflamed. No thrill or bruit could be heard over the neck. Examination of the chest showed impairment to percussion over the right apex and at both bases, and there were many râles throughout the chest. Examination of the abdomen, heart, and extremities revealed no abnormal findings.

The blood-pressure was 100 systolic and 60 diastolic. The temperature was 100° F.; pulse 100, and respirations 30. Urinalysis was negative. Examination of the blood showed a leukocytosis of 16,710. The blood-sugar was 120 mg. per 100 c.c. of blood, the blood-urea 35 mg. The blood Wassermann test was negative. Examination of the larynx by Dr. Hunter showed acute laryngitis. Both vocal cords showed normal function.

The diagnosis, at this time, was suppurative thyroiditis. Temporary treatment was by local applications of moist heat.

On June 5, 1928, Dr. Seelaus made an incision over the fluctuant mass

and released a large amount of purulent fluid. Exploration of the abscess cavity revealed a hard, irregular mass, which seemed to be calcified. Two rubber tubes and a cigarette-drain were inserted for drainage.

Following the operation there was marked improvement in the patient's condition and she was able to leave the hospital on June 22, 1928, with instructions to report to the surgical clinic for dressings, required by a small draining sinus.

After her discharge from the hospital, there had been several attacks of swelling and pain in the region of the operation, so that on July 23, 1928, it was thought best to have her readmitted to the hospital for further treatment.

Examination at this time showed a very large, soft swelling of the thyroid gland, which occupied the entire front of the neck. There was a small draining sinus on the left side, but no sign of fluctuation.

Treatment at this time consisted of frequent applications of a hot solution of magnesium sulphate. The basal metabolic rate was + 40 (the patient's temperature at this time being 99.6° F.).

After four weeks of local treatment and general supportive measures the acute symptoms had subsided; the soft swelling and tenderness had disappeared, and the temperature was normal. There still remained a marked nodular enlargement of both lobes of the thyroid gland with several areas presenting stony hardness.

Operation on August 24, 1928 by Dr. Burden. Nitrous oxid anesthesia. A subtotal thyroidectomy, with removal of portions of both lobes, was performed. A large mass invested with a thick fibrous capsule was encountered on the left side. No free pus was seen. Two strips of iodoform gauze and two small rubber tubes were inserted for drainage. Postoperative convalescence was uneventful and the patient was discharged from the hospital on September 4, 1928, at which time there was a small draining sinus in the anterior portion of the neck.

Pathologic report on excised tissue: Specimen consists of two lobes of the thyroid gland, the left lobe weighs 61 gm. and measures $7\frac{1}{2}$ x $4\frac{1}{2}$ x $3\frac{1}{2}$ cm. The organ is tough in consistency and a hard mass is palpable within its substance. On section the lobe is seen to be completely enclosed in a thick fibrous-tissue capsule, large strands of which weave in and out through the lobe. A cavity 1 x 1 cm. lined with fibrous tissue and containing a small amount of turbid fluid is seen within the middle of the lobe. This cavity is irregular and ramifying and is seen to contain an irregular branching calcareous stone. Smaller cavities are seen here and there containing smaller calcareous masses. Very little of the tissue is recognizable as thyroid.

The right lobe measures 6 x 3 x 4 cm. and weighs 50 gm. The lobe is soft, somewhat translucent in appearance, and an occasional calcareous plaque is seen on the surface. On section, moderate trabeculation is noted; on the posterior aspect near the middle of the gland, a yellowish-brown circumscribed area of tissue is noted. Remainder of section presents larger colloid filled alveoli.

Microscopic.—Left lobe. A diffuse and marked fibrosis is noted throughout; this is especially true of the capsule where concentric layers of fibrous tissue sandwich parallel layers of small active appearing acini. Within the

gland are seen many small acini, arranged in disorderly fashion lined by cuboidal and low columnar epithelium. Some of these contain a poorly staining watery colloid; others are without secretion. The vessels present a marked intimal thickening and many are thrombotic. Here and there are seen large focal collections of inflammatory cells, most of them being plasma-cells, and lymphocytes. Sections taken from the margins of the above-noted cavities are seen to be typical of abscesses. The walls contain many polynuclears with the deeper portions being infiltrated with plasma-cells. Near the superficial necrotic margins are seen some areas of calcification.

The right lobe presents a much more normal appearance with a parenchyma in which many normal acini are present. There is present, however, a very interesting adenomatous condition. Small circumscribed areas of tissue are seen to contain large dilated acini, between which is an abundant intercellular fetal tissue consisting of small groups of active appearing cells with deeply staining nuclei. The nodule above noted consists of small acini lined with cuboidal epithelium, quite typical of fetal adenoma.

Diagnosis.—(1) Toxic adenoma of thyroid. (2) Chronic purulent thyroiditis with calcification.

N. B.—The basal metabolic rate on September 20, 1928 was — 17.

Discussion.—The thyroid gland is only rarely affected by acute or chronic inflammation. Cases of thyroiditis have been reported following or during the course of scarlet fever and typhoid fever. Cases of this kind usually subside without active treatment and are rarely followed by untoward results. Pre-existing lesions in the gland, such as adenomata and cysts, seem to be predisposing factors, cases being reported in which active inflammatory changes and abscess formation have been superimposed upon these lesions. Thyroiditis sometimes follows an attack of sore throat or acute laryngitis. The relationship of trauma to the etiology of thyroiditis is not definite, but appears to have been a factor in the above-reported case. The inflammatory changes in the thyroid gland may extend to all portions of the gland or may remain well localized to an adenomatous or cystic area.

The microscopic picture shows the usual changes accompanying inflammation, such as infiltration by polymorphonuclear cells and small round cells. There is usually thrombosis of the smaller vessels which is probably due to the fact that there is little collateral circulation between the vessels in the gland itself.

The symptoms of thyroiditis include fever, local tenderness, swelling, hoarseness, due to an accompanying laryngitis, and

frequently dysphagia. Pain is often a prominent symptom because of the intracapsular tension. The gland may be stony hard and suggest malignancy, but may be differentiated from the latter by the history. The basal metabolic rate is usually elevated during the active condition, apparently from stimulation of the function of the gland and the elevated temperature. In the later stages, following the onset of extensive fibrosis in the chronic cases, the function of the gland is often subnormal, probably due to destruction of glandular tissue. This hypofunctional state of the gland, when persistent, may give rise to myxedema. It is probably true that when myxedema follows resection of the thyroid it is due not to the removal of too much tissue, but rather to inflammation and fibrosis of the remaining portions of the gland.

CHOLANGITIS

Cholangitis is a clinical and pathologic entity, presenting a diffuse infection of the biliary tract in which the bile channels are characteristically involved. The seriousness of this condition is dependent upon the extent of the infection, the consequent derangement of liver function, and the harmful, and often, permanent sequelæ.

A knowledge of the minute anatomy of the bile-ducts is necessary for a complete conception of the pathology of cholangitis (Fig. 373). The bile-ducts are not mere passive channels for the transit of bile, although this is their chief purpose. A close study of their structure reveals that they are lined by a modified type of columnar epithelium and that arranged along the walls of their lumen are numerous tiny evaginations. Emptying into these parietal saccules are ducts of glands which ramify most extensively in the walls of the principal ducts. These glands produce a mucous secretion which is collected in the parietal saccules and later is poured out into the duct. If one will take the trouble to make histologic studies of the common bile-duct from a case of cholecystitis in which the infection is grossly confined to the gall-bladder, he will frequently find in the parietal glands of the duct evidence of inflammatory changes

such as round-cell infiltration, edema, and cystic changes in the glands. It will be apparent that these changes often accompany cholecystitis and that more extensive involvement of the parietal glands of the ducts within and without the liver constitutes the chief pathologic feature of cholangitis. The infection in cholangitis is not confined to the surface of the lumen of the ducts, but

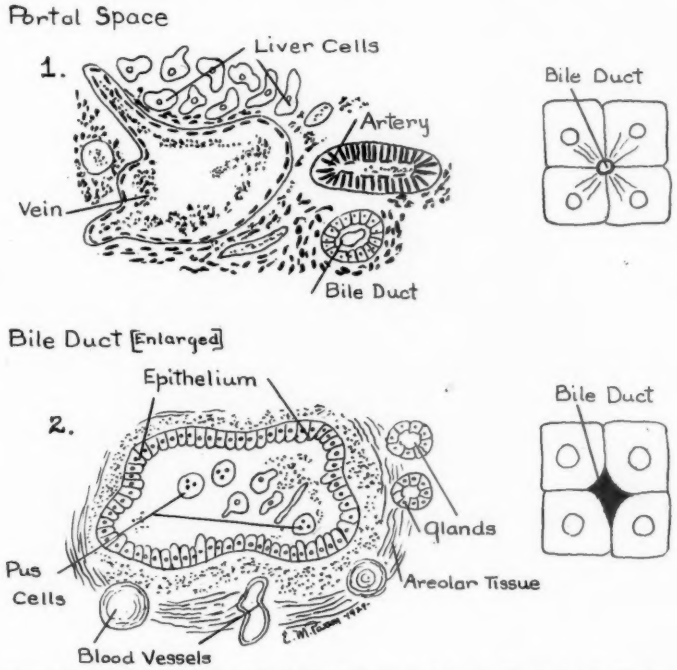

Fig. 373.—Anatomy of the bile-ducts (microscopic). 1, Normal. 2, Cholangitis.

is well entrenched deep in their walls, which accounts for the tenacity, seriousness, and difficult therapeutic management of this condition.

Cholangitis is usually accompanied by extension of the infection to contiguous structures. The most frequent associated lesion is cholecystitis and it is often difficult to ascertain

whether the infection in the gall-bladder is the primary focus or a secondary lesion. From experimental work and clinical studies it has been determined that cholecystitis may arise independently of infection in the liver. This can be accounted for, by a selective localization of bacteria, or according to the doctrine of a prepared soil as the result of a primary functional derangement of the gall-bladder, or by a combination of the two. It is not difficult to conceive that many cases of cholecystitis begin as a

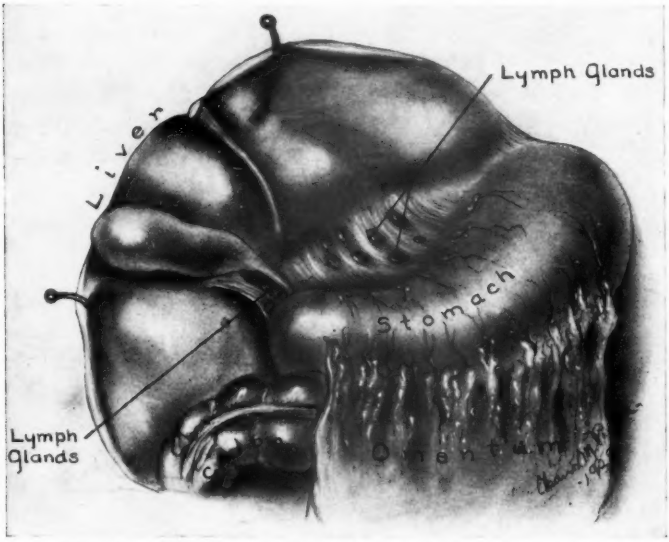

Fig. 374.—Enlarged lymph-glands in gastrohepatic omentum.

diffuse infection of the biliary tract and when the acute condition subsides the residual infection becomes localized to the gall-bladder where certain factors favor its chronicity.

When operating for cholangitis the surgeon frequently finds changes in the regional lymphatics, such as enlargement of the nodes in the hilus of the liver, at the junction of the cystic and common ducts, along the course of the common duct in the margin of the gastrohepatic omentum and even around the head of the pancreas (Figs. 374, 375). These nodes are often markedly

swollen and may actually cause obstruction to bile flow by pressure on the ducts. The finer lymphatic channels in the liver, especially those radiating from the region of the gall-bladder, are often distinctly seen. The condition actually constitutes a lymphangitis. The head of the pancreas is frequently swollen and soft, while the body and tail are not involved. The changes within the liver may cause this organ to be enlarged and congested. Sections of the liver will show inflammatory changes around the smaller bile-ducts and degenerative lesions—

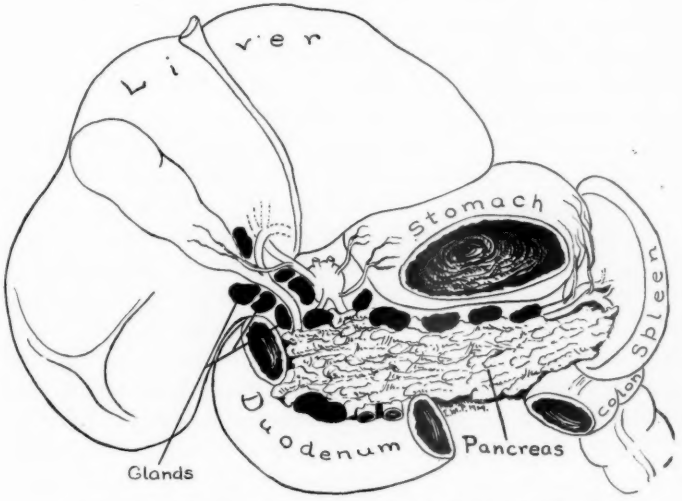

Fig. 375.—Enlarged lymph-nodes around liver and pancreas.

edema and cloudy swelling of the parenchymal cells. The intrahepatic lesions are usually confined to the right lobe, but in more severe cases the left lobe and even the spleen may also be involved in the infectious process.

Cholangitis is sometimes encountered in the course of the infectious fevers such as influenza, pneumonia, typhoid fever, and acute rheumatic fever. In such instances the symptoms pointing to involvement of the biliary tract are slight jaundice with pain, tenderness, and sometimes enlargement of the liver.

This type of cholangitis may be either toxic or infectious in origin, the jaundice is due to functional deficiency of the liver. There is also a primary type of cholangitis, infectious in origin, which begins with fever often septic in type, malaise, gastro-intestinal disturbance, and jaundice. This condition is sometimes confused with acute catarrhal jaundice, acute yellow atrophy of the liver, and with chronic pancreatitis. In cholangitis the infectious features predominate and the jaundice is only moderate in degree. Most of these cases subside in the course of several weeks and may completely clear up. It is not unusual, however, for the condition to recur. When the symptoms do not subside in due time, or become aggravated, there is urgent indication for surgical consideration and it is usually necessary to provide for external biliary drainage.

Cases of cholangitis are also seen where the early history is one of gastro-enteritis. In these the likelihood of an ascending infection either by way of the lumen of the common duct or along the neighboring lymphatics must be considered.

However, surgical experience shows that in the majority of cases of cholangitis there has been some pre-existing lesion of the biliary tract with a recent acute exacerbation of infection or interference to the flow of bile. As previously stated, the most common associated lesion is cholecystitis and its complications, such as stones in the gall-bladder and in the common duct. Stone in the common duct is usually associated with a choledochitis and, as we have previously shown, this infection is deeply interstitial. Acute exacerbation and extension of this smouldering infection in the duct ensue when there is prolonged partial or complete obstruction to bile flow. The infection may then rapidly involve the entire biliary tract giving rise to a septic state with intermittent chills and fever, persistent jaundice which may partially fade only to become deeper as the obstruction increases. If intervention is too long delayed the condition goes on to the formation of pus within the ducts, within the gall-bladder, and of multiple large or small abscesses within the liver itself. The gravity of the situation becomes proportionally greater as the surgeon's help is withheld, until the vital function

of the liver has been destroyed beyond hope of redemption by any means whatsoever. Stricture of the common duct may closely simulate calculus obstruction because the symptoms of both, with the exception of pain, are essentially those of cholangitis. A stricture may cause only partial obstruction to the bile flow, but with insidious, progressive, and often symptomless harmful effects on the liver as the result of back pressure. This condition is analogous to the renal damage due to urethral stricture and to chronic prostatic obstruction. Acute obstruction to bile flow occurs when there is reactivation of the infection about the stricture with edema and occlusion of the lumen. In the case of the common duct this means the onset of cholangitis.

For clinical purposes it is convenient to divide cholangitis into two chief types: acute and chronic. The former is represented by acute catarrhal and acute suppurative forms, while the chronic variety closely resembles hepatitis and biliary cirrhosis and is characterized by recurrent acute attacks of fever, slight jaundice, and painful swelling of the liver. A type of cholangitis which particularly concerns the surgeon is that which occurs after operations on the biliary tract. Occasionally after cholecystectomy the patient will have slight jaundice and fever for four or five days. During this time there may be anxiety on the part of the surgeon as to the possibility of injury to the ducts or an overlooked stone. Fortunately, in most instances, his anxiety is relieved by complete disappearance of the symptoms. This type of postoperative reaction is not alarming when it occurs after operations for acute lesions because the operative trauma is likely to result in some temporary reactivation or extension of the already existing infection; but its occurrence after operations for chronic lesions may be more disturbing and more difficult to explain. In these instances there may be a slight degree of cholangitis sufficient to interfere with the function of the liver and to cause jaundice. It is also possible that the trauma incident to the operation, especially in view of the close proximity of important nerve centers, may be a factor in causing a transient disturbance of liver function. The region of the biliary tract especially about the gall-bladder and ducts has

important reflex nervous connections which can be demonstrated under general anesthesia by making traction on the gall-bladder when it will be frequently found that respiration is temporarily interrupted. It is, therefore, important to reduce the necessary operative manipulations to a minimum. Thorough exposure of the parts by ample incision, the proper placing of gauze, and gentle traction will go far to accomplish this purpose. The danger of cholangitis is one of the chief reasons for postponing operation in acute lesions of the biliary tract until the patient is free of fever and until the infection has been well localized and the peritoneum protected by the formation of adhesions and the interposition of omentum around the infected area.

The symptoms of cholangitis are those of infection plus certain peculiar features related to the liver and its functions. In mild cases there is fever, malaise, and anorexia, slight jaundice and often an appreciable enlargement of the liver. The symptoms may persist for several weeks and the condition subside spontaneously. An accurate diagnosis may be difficult because of confusion with catarrhal jaundice, stone in the common duct, hepatitis, and pancreatitis. Laboratory tests are helpful to a certain extent but should not be implicitly relied upon. The van den Bergh test will serve to differentiate obstructive from functional jaundice. Estimation of the amount of serum bilirubin permits a daily observation on the degree of jaundice, so that the surgeon is able to know more or less accurately the progress of this phase of the condition. However, with the aid of, or in spite of favorable laboratory reports, the surgeon must exercise his own ripe judgment based on experience and on his estimate of the patient's condition as to the exact time for and the extent of the procedure to be adopted. In the severe type of cholangitis, characterized by septic fever, deep jaundice, and extreme prostration, the outlook is grave and while some form of drainage operation is urgently indicated, the surgeon must exercise extreme caution as to the proper time for intervention and his efforts should be confined only to the necessary minimum.

Chronic cholangitis closely resembles biliary cirrhosis, and

the treatment for both being essentially the same, distinction between the two is of little practical importance. In cholangitis there are recurrent attacks of fever, jaundice, enlargement of the liver which on direct inspection presents a mottled appearance and rounded edges (Fig. 376). In biliary cirrhosis the liver

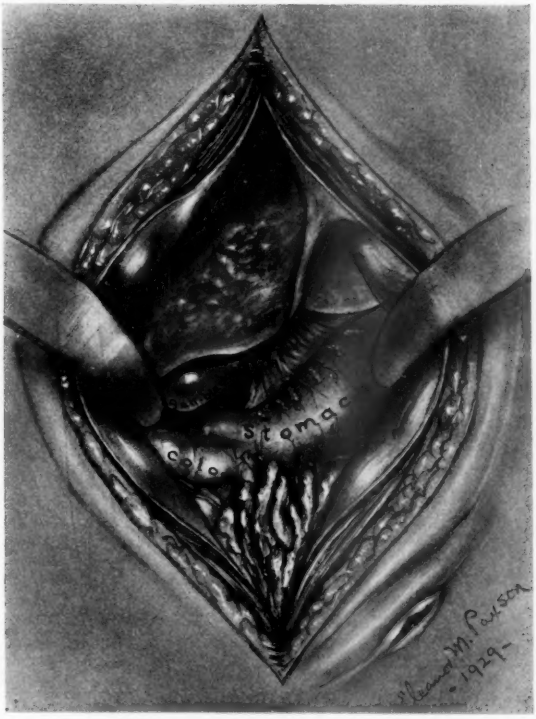

Fig. 376.—Liver with mottled surface.

is likewise enlarged but has a grayish or blue appearance and frequently presents radiating lines, the result of deposits of fibrous tissues (Fig. 377).

While the most frequent type of postoperative cholangitis runs a self-limited course and is not serious, there sometimes occurs a fulminating type in which symptoms are those of

extreme infection with quite marked hepatic insufficiency, deep jaundice, and myocardial degeneration. These cases usually terminate fatally.

Cholangitis, because of the mild initial symptoms, is occasionally mistaken for catarrhal jaundice. Careful daily observa-

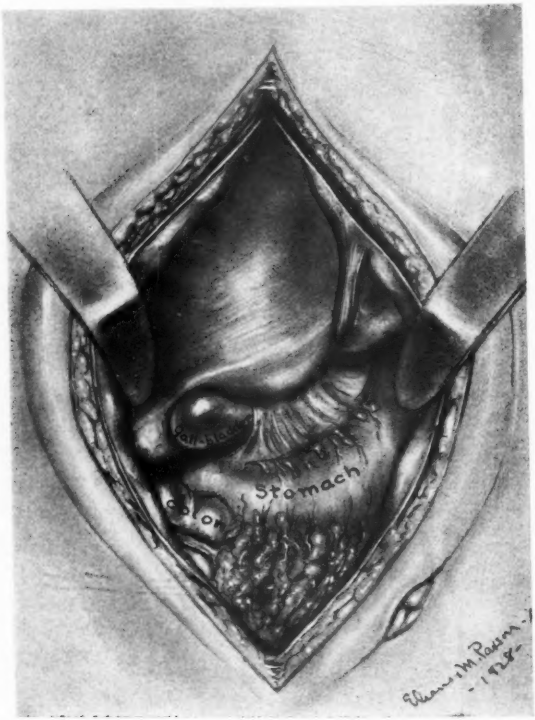

Fig. 377.—Liver with a round, thick edge.

tion, however, should establish the diagnosis, since in cholangitis the patient is sick, there is fever, but the jaundice is only moderate, while in catarrhal jaundice the patient is more jaundiced than sick.

The most important factor in the treatment of cholangitis is its surgical management. Regardless of the apparent type under

consideration an early surgical opinion should be sought and the case, preferably, should be directly under the surgeon's care. Any form of temporizing or medical treatment without surgical guidance is usually hazardous. This applies particularly to the primary type of cholangitis. The early surgical treatment of lesions of the biliary tract should be more widely adopted especially since present-day diagnostic methods, such as cholecystography, blood chemical studies, the van den Bergh test, and liver functional tests, have increased the percentage of early diagnoses. An early appeal for the surgeon's help, that is, early in the course of the disease, will do much to lower the mortality of disease of the biliary tract, to curtail morbidity figures, and to reduce the menace of such complications and sequelæ as cholangitis, chronic pancreatitis, and biliary cirrhosis. The actual surgical management of cholangitis requires careful and mature judgment. Drainage is the chief objective of any procedure that may be adopted. The manner in which this is to be attained must be determined by the conditions found at operation. The best immediate interests of the patient are of first importance, rather than ambitious surgical procedures. When the condition is acute, external drainage of bile should be provided for by the most direct means. At times, this may be most easily accomplished by cholecystostomy. When there is any doubt as to the efficiency of this method it should be supplemented by drainage of the common duct. For this purpose it is our practice to use a T-tube. By the use of this method of drainage it is possible to maintain an external escape for the bile over as long a period as desired. In a number of instances we have allowed the tube to remain in place for several years with beneficial results. The use of the T-tube serves several purposes: it provides for the external drainage of bile with the escape of infection, it reduces the intraductal and intrahepatic tension, and it also permits the flow of some bile down the common duct and into the duodenum. Removal of the T-tube is accomplished by traction and without injurious effects. We very seldom use internal biliary drainage by cholecystogastrostomy or cholecystoduodenostomy for the following reasons: external biliary

drainage is preferable in cases of infection; the stoma of an anastomosis does not long remain patent when the common duct is not obstructed; and the presence of an anastomotic opening may actually favor the ascent of infection from the stomach or duodenum into the gall-bladder and the upper biliary tract.

In conclusion we may emphasize the following important points: the resistant nature of the infection in cholangitis is explained by the minute anatomy of the bile-ducts; the seriousness of the condition is dependent on the extent of the infection and the derangement of liver function. The important factor in the proper management of this type of infection is the provision for biliary drainage. A certain percentage of cases are mild in type and recover spontaneously, but these cannot be differentiated with certainty unless the patient is under daily observation and preferably in the care of an experienced surgeon.

GENERAL SURGICAL CLINIC OF DR. W. WAYNE BABCOCK

SAMARITAN HOSPITAL AND TEMPLE UNIVERSITY

OPERATIVE DECOMPRESSION OF AORTIC ANEURYSM BY CAROTID-JUGULAR ANASTOMOSIS

Case I. (Referred by Dr. Joseph B. Wolffe).—Mrs. X. B., Jewish, age forty-five years, married.

Chief Complaint.—Precordial pain, dyspepsia, pulsations in extremities, dyspnea and angina on exertion, cardiac palpitation, occasional edema of ankles, nocturia, slight cough with thick mucoid expectoration.

Present Illness.—Four years ago pain began in right lower abdominal quadrant, which, radiating toward the back, was associated with dyspepsia. It was not relieved by alkalies nor by eructations of gas, but by free purgation. There was slight precordial discomfort. A diagnosis of gall-bladder disease was made and an upper right abdominal operation performed in 1926. In 1927 a hernioplasty was done. Edema of both legs and ankles and puffiness about the face appeared. The patient began to tire easily, developed marked palpitation and dyspnea on exertion, throbbing headaches, nocturia, and a slight cough, chiefly present at night or when recumbent, and accompanied by the expectoration of thick mucous plugs. Angina on exertion has prevented the patient from working for the last eighteen months.

Previous History.—Patient had the usual childhood diseases including measles, whooping-cough, scarlet fever, diphtheria, and "shaking fever" (chorea). Menses began at twelve years, regular; one pregnancy with normal delivery at the age of twenty-six, child living and well; menopause eight months ago.

Physical Examination.—A fairly well-developed woman showing puffiness about the face and a reddish blush about the eyes. Pupils are unequal, the left is dilated with absent light reflex. Right pupil of normal size and reacts sluggishly to light. Teeth are in poor condition, tongue coated, tonsils hypertrophied. Pulsation of both carotids is visible. The pulsation of the subclavian arteries is unequal. The heart is markedly enlarged, chiefly to the left; the apex beat is diffuse and palpable in the sixth interspace, 7½ cm. from midline. The apex is negative for murmurs; a regurgitant murmur is heard in the aortic area, transmitted to the vessels of the neck with a blowing sound in the second interspace to the right and left of the sternum. Examination of the lungs is negative. Abdomen flabby, relaxed, with scars of two previous operations; abdominal aorta palpable; extremities show reduced knee-jerks; radials somewhat sclerotic and unequal; the pulse is of the water-hammer type.

Fig. 378.—Transverse incision upon the neck for carotid-jugular anastomosis.

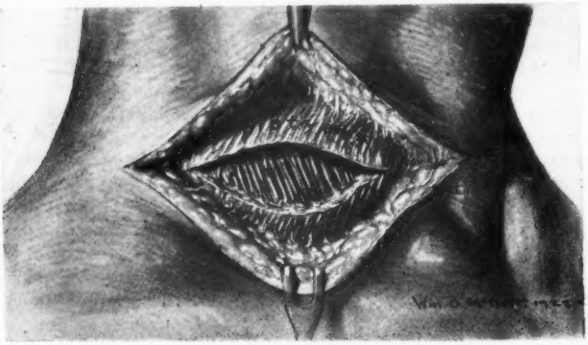

Fig. 379.—Carotid-jugular anastomosis. Transverse division of superficial fascia and platysma exposing the sternocleidomastoideus.

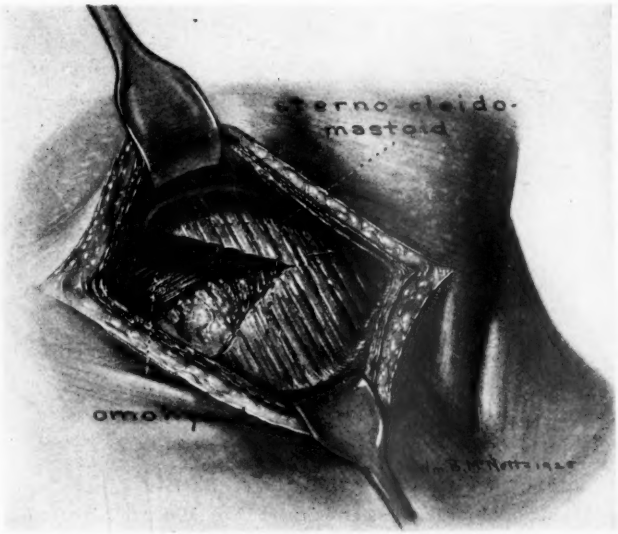

Fig. 380.—Carotid-jugular anastomosis. For sufficient exposure it usually is desirable to partially or completely divide the sternocleidomastoideus.

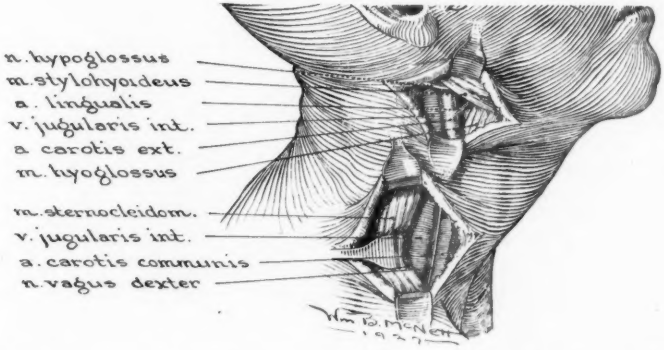

Fig. 381.—Carotid-jugular anastomosis; showing the anatomical relationship of the common carotid artery, internal jugular vein, and vagus nerve.

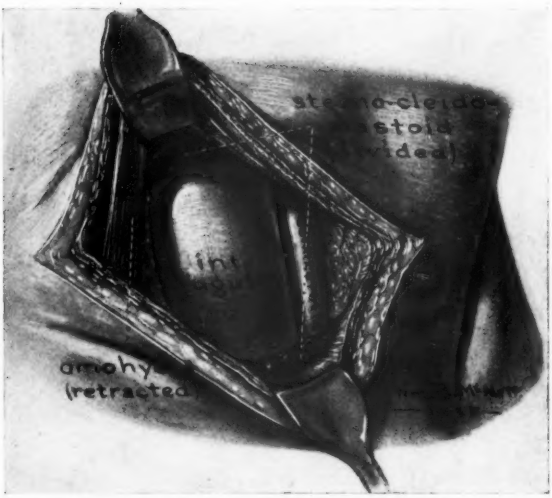

Fig. 382.—Carotid-jugular anastomosis. The carotid sheath has been opened, exposing the internal jugular vein.

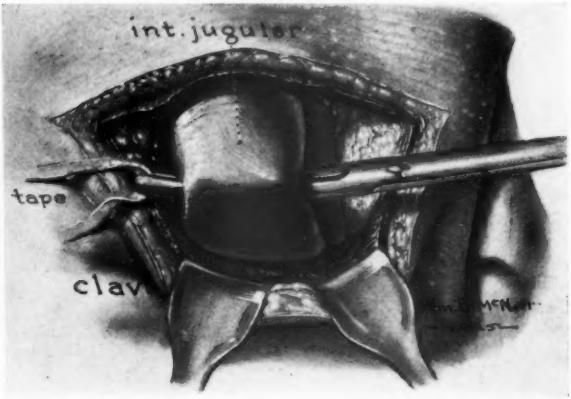

Fig. 383.—Carotid-jugular anastomosis. The vagus and descendens hypoglossi nerves have been carefully displaced and a narrow tape is being gently carried about the internal jugular vein.

Blood-pressure.—June 10, 1929, right 185/10; left 195/10.

Laboratory Examination.—Urine negative; blood Wassermann negative; CO_2 volume per cent., 62.

Electrocardiograph.—Marked left ventricular preponderance, C wave rapid downward slope, slight evidence of impairment of conductive time, marked high tracheal pulsations.

Fig. 384.—Carotid-jugular anastomosis. To control the circulation in the artery and vein during the anastomosis and also to ascertain the amount of back pressure in the vein, tapes are fastened about the vessels so as to interrupt circulation. The artery and vein are ligated above by silk, divided below the ligatures, and aided by three guide sutures, an end-to-end anastomosis of the proximal ends is made with fine arterial silk. The tapes are then removed and the deeper layers of the wound carefully closed, without drainage, by fine black silk. On account of the tissue reaction produced it is considered undesirable to use catgut in the neighborhood of a vascular anastomosis.

Roentgenogram.—Fluoroscopic examination shows saccular aneurysm of the arch of the aorta.

Clinical Summary.—Pulsations of radials and carotids greater on right

side than on left; heart markedly enlarged to the left; marked widening of supracardiac area of dulness. Aneurysm of ascending and transverse arch of luetic type with associated myocardial disease and effort angina.

Operation.—June 18, 1929. Temperature 97.3° F., respirations 22, systolic pressure 174.

Anesthesia by local infiltration with 1 per cent. procain adrenalin solution after 3 injections of morphin sulphate 0.01 gm., scopolamin hydrobromid 0.0004 gm.

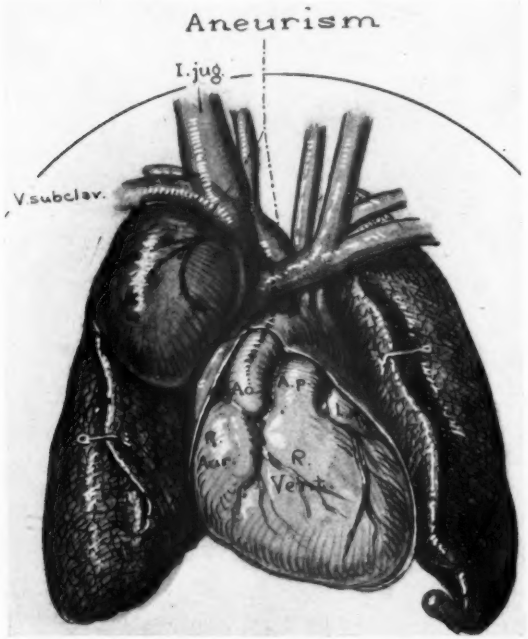

Fig. 385.—Illustrating the back pressure upon the innominate vein from an aneurysm of the ascending part of the arch of the aorta.

Carotid-jugular End-to-end Anastomosis, Right.—Seven cm. transverse incision, 2 cm. above the right clavicle. Common carotid and internal jugular doubly ligated distally by black silk. Circulation controlled by temporary tape ligatures. Artery divided about 2½ cm. above the vein to allow for curve. Artery slightly atheromatous. End-to-end anastomosis with fine black arterial silk and three fine stay sutures. After the vessels were liberated the vein did not regain its previous large size but approximated that of the artery which was about one-third the diameter of the

vein. The vein was extremely thin and fragile—about the thickness of tissue paper and through the thin walls the rushing arterial torrent could easily be seen. A small area of leakage due to cutting of a silk knot was easily controlled. A marked bruit followed the operation. No evidence of shock or reaction from the anastomosis. During the operation respirations fell to 18 and the pulse dropped from 148 to 120, probably due to narcotism.

Postoperative course nearly uneventful except for early deep narcotism followed by nausea and vomiting. Pulse was 110 on leaving operating room and

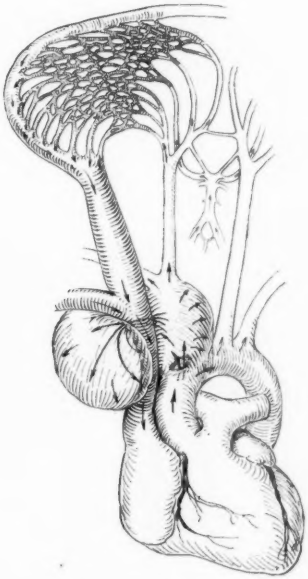

Fig. 386.—Aneurysm of the aorta, showing diagrammatically the circulation in the skull from the carotid and vertebral arteries and the return circulation on the right side through the cerebral sinuses and internal jugular vein.

100 forty hours after operation. A slight hacking cough was noted sixty hours after operation, but the chest remained clear. Postoperative blood-pressure: right arm, 138/10; left arm, 124/10. June 22, 1929, right arm 154/0; left arm, 149/0. Plasma CO_2 volume per cent., 60. Electrocardiograph showed increase in right-sided volume.

Primary union of wound, improvement in subjective symptoms, marked bruit over lower right side of neck. Especially striking is the relief from the angina. After being an invalid for the last eighteen months the patient has been able to resume her housework.

Comment.—Four years ago, in September, 1925, I first attempted to decompress a thoracic aneurysm by an end-to-end anastomosis between the common carotid artery and the internal jugular vein. Following the operation the large aneurysmal sac, which had perforated the ribs, became reduced in size, the pain largely disappeared, and the man is still living, clinically much

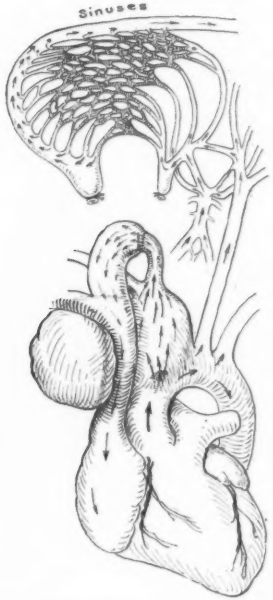

Fig. 387.—Illustrating the alterations in the intracranial circulation after decompression of an aortic aneurysm by end-to-end anastomosis between the common carotid and internal jugular vein. It is believed that the danger of cerebral complication from division of the common carotid artery is reduced by the simultaneous ligation of the vein.

improved over his preoperative condition. The operation has now been attempted by various operators over 13 times with accumulating evidence of its value to reduce the pressure within the aneurysmal sac, to relieve pain, and to prolong life in cases of large aneurysm of the arch of the aorta. Cerebral com-

plication due to ischemia from the operation is apparently rare and it is probable that simultaneous ligation of the jugular vein prevents the harmful cerebral anemia and hemiplegia which in about 25 per cent. of cases follow the simple ligation of the common carotid artery. Should a sufficient degree of decompression not be obtained by the first operation, we have con-

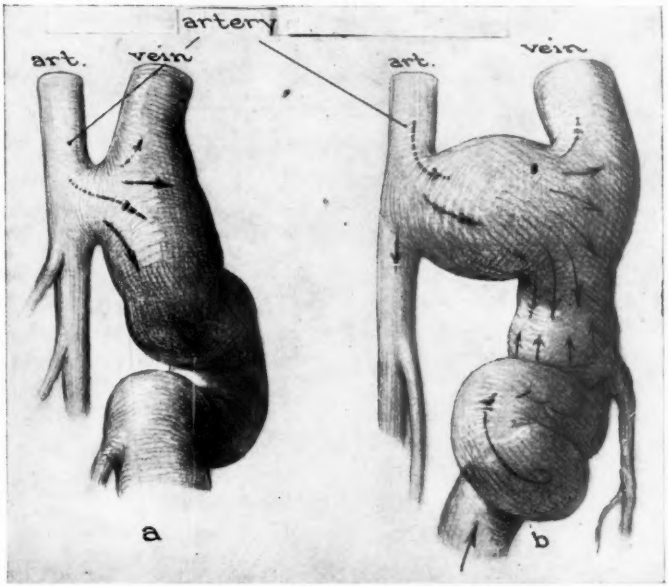

Fig. 388.—Illustrating the disastrous effect upon the venous circulation from the lateral anastomosis of an artery and vein. The vein greatly dilates and the venous circulation is impeded or reversed. From an end-to-end anastomosis directed toward the heart, the vein, if at least of equal calibre to that of the artery, does not dilate and the venous circulation is facilitated and augmented.

sidered the possible desirability of a double anastomosis, using in the secondary operation upon the opposite side of the neck a subclavian union. Thus far, this has not been required and excluding cases in which there is a technical defect in the anastomosis it would seem to be a remote necessity. As an alterna-

tive method, an anastomosis between the subclavian artery and vein also has been considered as being possibly preferable in certain cases, although technically more difficult than the carotid-jugular union. For an aneurysm of the abdominal aorta, a decompressive operation of the same type, by dividing the

Fig. 389.—Patient with aneurysm of the arch of the aorta which had perforated the bony thoracic wall, after the carotid-jugular anastomosis performed September, 1925. Patient is living and the symptoms have markedly improved since operation. The scar seen upon the neck is the seat of a strong bruit; the protrusion of the right upper thorax from the perforating aneurysm is shown.

iliac artery and vein with an end-to-end anastomosis of the proximal ends, is technically entirely feasible. We have been impressed by the sufficiency of the very thin and apparently fragile jugular vein in withstanding the torrent of arterial blood that rushes into it after the anastomosis. The use of a longer

segment of artery was tried in this case to avoid the extra stress at the curve but is not advised. The thick-walled artery is rigid and difficult to bend into a curve whereas the thin-walled vein seems to be entirely competent to withstand the extra arterial pressure around the curve after an end-to-end union. There was no evidence of undue stress from the presence of the arterial blood-stream. The vein not only did not dilate but showed by its reduced size that the wall pressure was less. Likewise, very fine arterial silk has proved to be amply strong for the anastomosis, and I have encountered no special difficulty from leakage along the line of anastomosis.

These observations emphasize the hydrodynamic law that pressure upon the walls of a tube containing a moving liquid progressively decreases as the velocity of the liquid is increased. Emphasis should again be made however upon the fact that a lateral or side-to-side anastomosis between an artery and vein may do great harm. The effect is quite different from that of an end-to-end union, which is the only type to be considered as a therapeutic measure (Fig. 388).

CAROTID-JUGULAR ANASTOMOSIS IN THE TREATMENT OF ADVANCED PULMONARY TUBERCULOSIS

Case II. (Referred by Dr. Joseph Ulman and Dr. Richard J. Bennet).—White, male, age twenty-eight years.

Present Illness.—Began while in bed with a broken ankle in June, 1928, with pain across the chest which continued after return to work. Night-sweats and pleurisy developed; there was cough with profuse expectoration and a loss of 30 pounds in weight. For the past four weeks patient has had a running ear and recently a sore throat.

Family History.—Father died of asthma, mother of quinsy.

Previous History.—Had gonorrhea ten years ago, uses alcohol moderately, smokes occasionally, denies drug addiction. No history of other serious disease.

Physical Examination.—Patient fairly well-developed and nourished, lies quietly in bed, shows no evidence of cyanosis, anemia, or jaundice, has a persistent productive hacking cough. Pharynx is slightly injected. Left ear, purulent discharge, without tenderness over the mastoid. Thorax is well-developed, symmetrical, without scars, expansion is poor; tactile and vocal fremitus are increased throughout both lungs. Percussion: Upper half of the right and entire left lung show marked impairment. Auscultation: Breath sounds in right lung are prolonged and have an amphoric quality at the apex. Showers of crackling râles are heard with each respiration and persist after cough. Breath sounds are amphoric in left lung below the clavicle, and slightly prolonged elsewhere; many fine and medium crackling râles are heard. Extremities are negative except for slight clubbing of the fingers. Blood-pressure, 120/60. Urinary examination is negative; Wassermann negative; blood chemistry shows sugar 74 mg., urea 14 mg. *Sputum*, 4/29/29: Many tubercle bacilli per field. 5/1/29: Many tubercle bacilli per field.

Roentgenogram, April 30, 1929.—Chronic ulcerative pulmonary tuberculosis involving entire left lung and upper portion of right, with cavitation in both upper lobes. *Blood*, May 21, 1929: Red blood-cells 4,700,000; leukocytes, 11,050; polymorphonuclear leukocytes, 90 per cent.

Patient selected, with his full consent, for trial of the new operation, as having a hopelessly advanced type of bilateral pulmonary tuberculosis.

Operation, 5/21/29.—Narco local anesthesia; 8-cm. transverse incision, two fingerbreadths above the medial half of the right clavicle; sternocleidomastoideus partially divided, internal jugular vein found to be moderately dilated, internal carotid artery of average size, right internal jugular vein and common carotid artery divided, distal ends ligated, proximal ends anastomosed end-to-end by fine arterial silk, no leakage along suture line. The strong arterial current could be seen through the thin translucent vein and produced marked palpable bruit. Wound closed in layers without drainage.

5/22/29: Coughs considerably, slight pain at site of anastomosis.

5/23/29: Temperature not above 99.6° F.

5/25/29: Cough reduced under temporary use of small doses of codein; unusually easy convalescence.

5/30/29: All sutures removed—primary union—strong bruit over lower right neck.

	Before operation.	One to four days after operation.	Four to seventeen days after operation.
Temperature.....	98.2–100.6	97.0– 99.6	97.4– 98.8
Pulse.....	76.0–100.0	80.0–112.0	80.0–106.0
Respiration.....	24.0– 36.0	20.0– 30.0	20.0– 24.0

Conditions on Discharge.—Improved, marked thrill palpable over site of anastomosis and faintly audible to patient—cough and expectoration markedly lessened—subjective sense of improved health—no cerebral complication.

Comment.—Tuberculosis is a disease in the active stages of which it has been found desirable to reduce the expended energy of the body as much as possible. Rest is the keynote of the modern treatment of pulmonary tuberculosis. The operations that are now being employed for its relief aim to compress and reduce the function of the affected lung. Artificial pneumothorax, phrenicotomy, thoracoplasty are examples of operations of this type. All reduce the capacity of the lung, so that for equal aëration of the blood the patient must respire more frequently or more deeply. While the compressed portion of the lung may work less, the thorax as a whole must labor more to provide a respiratory interchange of gases equal to that existing before the operation was performed. Despite this disadvantage, the compression operations have been found very valuable in the treatment of phthisis. But suppose that in the scheme of providing general rest, we should also give the lungs relief from work beyond that afforded by rest in bed, by reducing the required frequency and amplitude of the respiration, much as we give the heart rest by reducing the number of its beats. It would seem very desirable to give the lung rest by increasing its essential functional capacity.

Assume that without reducing the oxygen-carbon dioxid interchange we reduce the respirations of a bedfast tuberculous patient from 34 to 24 a minute; this would mean a saving of 10

inspirations and 10 expirations a minute, with the associated energy expended in moving the thorax and diaphragm. In one hour the patient would be saved the work required by 600 respirations; in one day, 14,400—a very appreciable saving of energy and of movement of the diseased lung. Would not this seem of advantage during the active stage of pulmonary tuberculosis, a period during which it is so desirable to relieve the patient of every bit of unnecessary effort? Assume that with this conservation of respiratory energy, the circulation through the lungs was so increased as to produce a hyperemia about the tubercles, a condition long considered very advantageous in the treatment of tuberculosis. Tubercles are essentially avascular and measures to increase the blood-supply to the tubercle have been used for many years. Witness, for example, the use of tuberculin and of Bier's method by artificial hyperemia. If rest, hyperemia, and increased functional capacity of the lung can be obtained without increased effort on the part of the heart, would it not seem that the patient should be in a more favorable condition for the healing of the pulmonary lesion? At least, such theory has for several years appealed to me and this patient presents the first clinical test. The patient was selected as having a bilateral hopelessly advanced form of pulmonary tuberculosis and the object of the operation, as stated, has been to decrease the work and to increase and modify the blood-supply of the affected lung. From the fourth to the seventeenth day after operation, the respiratory rate has shown an average decrease of 8 per minute, or a saving of 480 per hour, or 11,520 respirations per day, as contrasted with the preoperative rate. The temperature range has been distinctly lower than that before the operation; the cough and expectoration have decidedly decreased, and the patient thinks that he is much better. We trust that he is not over-optimistic, and as one who gladly accepted the risks of the first experimental operation we feel that he deserves to recover and hope that the previous gloomy prognostications of his medical advisers may be in error. It need not be emphasized that the operation is in an experimental stage and much more evidence will be required to establish its value or otherwise.

The operation, like that for the thoracic aneurysm, consisted in bi-passing a generous percentage of arterial blood from the aorta back to the right heart, to mix with the venous blood entering the lung, and by its high velocity accelerate the pulmonary circulation and, by its high oxygen content, decrease the rate or amplitude of the respirations. The lung, therefore, continuously receives partially oxygenated blood and never wholly venous blood. There is in part a double oxygenation and from the ensuing reduced CO_2 content in the blood a lessened stimulation of the respiratory center in the medulla is to be expected with a slowing of the respirations. Apparently this has been accomplished.

Tissues do not live upon venous blood; anoxemia is followed by cellular degeneration and death, occurring promptly in the cells of the central nervous system, slower in those of parenchymatous organs, and eventually in the simpler tissues of the body. Note, for example, the results of a prolonged nitrous oxid anesthesia with insufficient oxygen; and the degeneration and the necrosis and ulceration of the leg from venous blood remaining in contact with the tissues where there are incompetent varicose veins. Tissues cannot live on venous blood. Evidence that the great flow of venous blood from the pulmonary arteries is insufficient for the nourishment of the lungs is shown by the separate lesser pulmonary circulation which carries arterial blood to the lungs. By the operation we have performed upon this patient a large supply of fresh arterial blood also enters the lungs through the pulmonary arteries producing what may be a new and supplemental source of nourishment. There may be present in the oxygenated blood other and more subtle chemical substances than are yet understood and these may be capable of further modifying the tuberculous processes.

The technical method of bi-passing the blood from the aorta back to the right heart and lungs is precisely that described in the treatment of the thoracic aneurysm. That the volume of arterial blood returned to the lungs is not inconsiderable, will I think be admitted by anyone who has witnessed the operation.

PHRENICOTOMY FOR PULMONARY TUBERCULOSIS

Case III.—Miss Elizabeth S., age twenty-four years, white, single; occupation, cashier; admitted to the Service for Diseases of the Chest, Samaritan Hospital, under the care of Dr. Louis Cohen and Dr. F. H. Krusen, March 20, 1929.

Chief Complaint.—Cough, expectoration, dyspnea, pain in the chest and shoulder upon coughing.

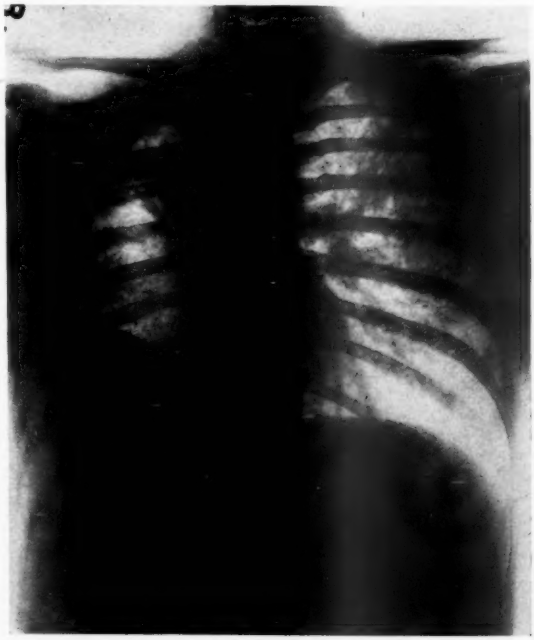

Fig. 390.—Roentgenogram of Case III before phrenicotomy for pulmonary tuberculosis.

Previous History.—In December, 1926, patient developed cough, expectoration, loss of weight, and a diagnosis of pulmonary tuberculosis was made. She was admitted to Eaglesville Sanitarium, December, 1926, where she improved and was discharged as an arrested case in December, 1927.

After six months further rest at home, she returned to work. Six months later, following an attack of influenza, all previous symptoms returned and the patient has been in bed for three months with cough, expectoration, pain in the chest, and increased temperature. Menstrual and genito-urinary history are negative.

Physical Findings.—Patient fairly well nourished; blood-pressure 125/70; head, neck, and mouth negative except for slightly injected tonsils; chest is

Fig. 391.—Roentgenogram of Case III showing ascent of diaphragm following avulsion of phrenic nerve, associated with reduced cough and expectoration.

flat; respirations costo-abdominal with respiratory lag on the right side. There is increased vocal fremitus at both right and left apices and at the left base. There is absence of vocal and tactile fremitus at right base with absent breath sounds; whispered pectoriloquy at both apices, especially the right side anteriorly; moist râles at apices. Abdominal examination, negative.

Sputum negative for tuberculosis, with and without antiformin negative. No tubercle bacilli found in urine; inoculated guinea-pigs died on second day. Urine shows cloud of albumin, hyaline and fine granular casts, and numerous leukocytes. Blood Wassermann negative; hemoglobin 4,250,000; leukocytes 15,350; polynuclears, 8 per cent.; small leukocytes, 40 per cent.; large lymphocytes, 2 per cent.; mononuclears, 2 per cent.; transitionals, 2 per cent. Phenolsulphonphthalein return: 60 c.c., 18 per cent.; 200 c.c., 25 per cent.; 195 c.c., 30 per cent.

Twenty-four hours after admission to the Samaritan Hospital three unsuccessful attempts were made to produce artificial pneumothorax by introducing a needle in the right infra-axillary region, in the right midclavicular line. Forty-eight hours later, two attempts—also unsuccessful—were made on the right side, in the right posterior axillary line at the sixth, and in the right midclavicular line at the second interspace, followed by the expectoration of bloody sputum.

The patient was transferred to the surgical service 3/25/29 with a diagnosis of bilateral pulmonary tuberculosis and pleural adhesions preventing artificial pneumothorax, with a request for phrenicotomy. While in the hospital the patient had developed a nephritis with albumin, casts, leukocytes, and blood in the urine.

Roentgenogram, 3/30/29.—Left lung fairly clear, right diaphragm 2 inches higher than normal, scattered areas of consolidation throughout the right lung; heart drawn to right side of chest, apparently by adhesion between pericardium and pleura. Diagnosis: Pulmonary tuberculosis and adhesions, especially of the right chest.

Operation, 4/4/29.—Temperature, 98° F.; respirations, 22; blood-pressure 100/78. Anesthetic—narco—local with infiltration by 1 per cent. procain-adrenalin (30 c.c.). *Operation: Exeresis*, right phrenic nerve, 6-cm. transverse incision 5 cm. above the clavicle centering over lateral margin of sternomastoid. Phrenic nerve exposed on scalenus anterior and, when pinched, convulsive movements noted in lower right chest with pain. Nerve infiltrated with procain solution, divided, distal ends slowly wound about a hemostat, 15 cm. being removed before the nerve ruptured. Postoperative condition satisfactory. Vomiting and nausea, probably from the narcotics, continued for fifty hours. Excursions of the right chest limited. Postoperative pulmonary symptoms distinctly better than those present before the exeresis.*

Case IV.—Mrs. M. McG., white, age thirty years, admitted 4/2/29 to the Service for Diseases of the Chest, Samaritan Hospital, under Dr. Louis Cohen and Dr. F. H. Krusen, for the production of artificial pneumothorax.

Previous History.—Persistent cough, thick, yellowish expectoration beginning with a "cold" two years ago; does not cough at night, but the cough and expectoration are marked in the morning; no night-sweats. Usual childhood diseases. Menstrual history negative, married ten years, no pregnancies.

Physical Examination.—Patient fairly well developed and nourished.

* This patient has recently died of an acute nephritis.

Head, negative. Chest, well developed, respiratory excursion equal on both sides, moist râles over upper right lobe, increased tactile fremitus on right side, moist râles over entire right lung, especially apex; left lung, negative. Heart, abdomen, and extremities negative. Urine, negative. Blood: Hemoglobin 5,130,000; leukocytes, 10,800; polynuclears, 72; small leukocytes, 21; large leukocytes, 5; transitional, 1; Wassermann, anticomplementary.

Roentgenogram, 4/2/29.—Tuberculous lesion at apex of right lung with cavity about 3 cm. in diameter.

April 11, 1929, no evidence of pneumothorax after attempts to introduce gas had been made.

Fig. 392.—Scar from phrenicotomy, Case IV.

April 19, 1929, extensive tuberculous infiltration of upper portion of both lungs, chiefly on right side; heart retracted to right evidently from adhesions to the pericardium.

Six attempts were made to produce artificial pneumothorax, but were unsuccessful as a result of pleural adhesions.

Patient was referred to the Surgical Service with a request for phrenicotomy on April 16, 1929.

Operation, 4/23/29.—Five-cm. transverse incision, laterally from outer border of sternomastoid 6 cm. above clavicle; phrenic nerve divided and wound about a hemostat. The strong pull of the diaphragm upon the nerve during traction was very evident. Ten and one-half cm. of the nerve removed. Temperature 98.4° F.; pulse 92; respirations 22; blood-pressure 120/78.

Postoperative.—Nausea for twelve hours, no increase in pulse or temperature, respiratory rate unchanged; marked diminution in movements of right

chest. Cough and expectoration absent; wound healed by first intention; patient discharged seven days after operation. Roentgenogram—diaphragm is elevated about 3 cm. above the level present before operation.

On June 7, 1929 patient was readmitted to the Surgical Service, having gained weight and having been free from cough and expectoration since her discharge from the hospital. There was leukocytosis of 21,000 and a polymorphonuclear count of 80, from an acute attack of appendicitis. An acutely inflamed

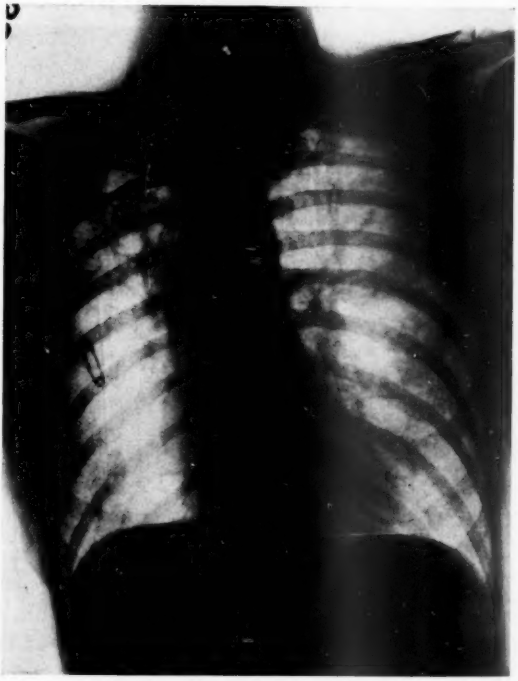

Fig. 393.—Roentgenogram—Case IV—before phrenicotomy for pulmonary tuberculosis.

appendix was removed by Dr. John Leedom, on emergency service, twenty-nine hours after the onset of symptoms. Operation under spinal anesthesia without difficulty. There was secondary colon bacillus infection in the wound; otherwise, the convalescence was uneventful.

Comment.—The diaphragm is supplied by the phrenic nerve derived from the third, fourth, and fifth cervical nerves, sym-

pathetic fibers from the cervical and splanchnic nerves and also, in 80 per cent. of persons, by the accessory phrenic coming from the fifth cervical root. As the simple phrenicotomy of Thiersch may fail to give the complete unilateral paralysis of the diaphragm desired, this operation has been supplanted by the radical phrenicotomy of Goetze in which the accessory phrenic

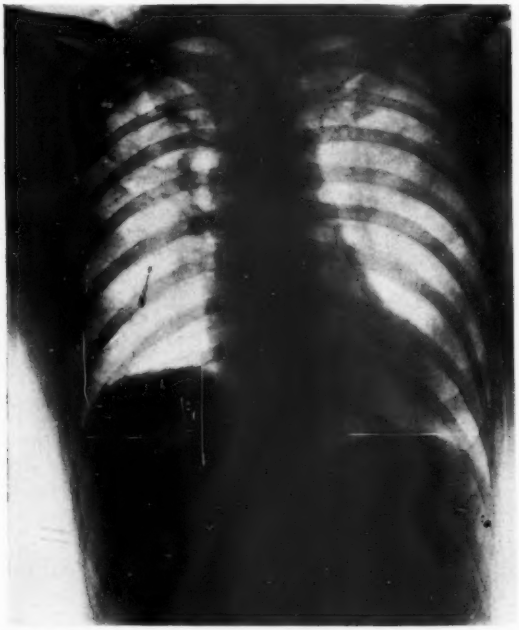

Fig. 394.—Roentgenogram—Case IV—showing ascent of diaphragm after avulsion of phrenic nerve. Associated with complete relief from cough and expectoration.

is located and also divided where it runs with the nerve to the subclavius. In turn, radical phrenicotomy, owing to the possible difficulty in locating and dividing the accessory phrenic nerves, has been supplanted by the phrenico-exairesis of Felix, in which by avulsing preferably 12 cm. or more of the peripheral portion of the phrenic nerve, the point of junction between the

phrenic and accessory phrenic—which usually lies between the first rib and root of the lung—is destroyed. This operation insures a complete paralysis of the corresponding half of the diaphragm. The paralyzed diaphragm then rises in the chest, reducing the isolateral thoracic cavity from one fourth to one third. The operation increases the effect of a previous artificial pneumothorax or it may be used, as in the two cases cited, when pneumothorax by reason of pleural adhesions or other cause cannot be accomplished. Both of the patients here presented have apparently been decidedly benefited by the operation. In one patient the cough and expectoration immediately stopped after the diaphragm was paralyzed.

Technic.—The operation, while it must be exact, is not as a rule difficult for one familiar with the anatomy of the neck. It need produce little disfigurement and may be done within ten or twenty minutes without the use of a general anesthetic. We prefer to seminarcotize a tuberculous patient by a hypodermic injection of morphin, 0.01 gr., scopolamin, 0.005 given one hour before the time of operation and repeated after twenty minutes if a sufficient narcosis is not produced. Local anesthesia, obtained by infiltrating with a 1 per cent. procain-epinephrin solution, is used immediately before the operation. A transverse incision, preferably along a wrinkle line of the neck, is made centering over the posterior border of the sternocleidomastoideus at the level of the cricoid or the carotid tubercle. The incision, according to the amount of fat in the patient's neck and the operator's experience, may be from 2 to 8 cm. in length. The incision is placed above the omohyoideus, where the phrenic nerve lies upon the scalenus anterior, which it obliquely crosses and where it is well separated from the carotid sheath and the associated vagus and descendens hypoglossi. The incision is deepened through the superficial fascia and platysma to the lateral margin of the sternocleidomastoideus which is retracted mesially, the layer of fat, lymph-glands, and deep cervical fascia is penetrated, exposing the surface of the scalenus upon which the nerve is usually to be found. Lateral to the scalenus are the cords of the brachial plexus; medial, the internal

jugular vein; below, the omohyoideus. Upon the scalenus, running obliquely downward from its lateral to its medial border, the phrenic nerve is located. On pinching the nerve, one or more of the following effects may be noted: pain referred to the shoulder, upper arm, chest wall or neck on the same side, or to the heart or diaphragm; spasmodic fluttering of the diaphragm; contractions of the isolateral lower thoracic wall; dilatation of the corresponding pupil or singultic movements. If the proximal portion of the nerve has been blocked by the injection of a local anesthetic, these effects may be modified. Rather rarely, the phrenic passes through the substance of the scalenus and is more difficult to locate. Having positively identified the nerve—for several deaths have occurred where the vagus was mistaken for the phrenic and avulsed—the nerve is divided and the peripheral portion is slowly and cautiously wound upon a hemostatic forceps, one complete turn of the forceps being made each minute. With care, from 12 to over 22 cm. of the nerve may be withdrawn before it ruptures. It is desirable to avulse at least 12 cm. to insure the division of all fibers of both the phrenic and accessory phrenic. By infiltrating the region of the third, fourth, and fifth cervical roots, the pain of the avulsion is prevented. Rarely, severe bleeding may occur from rupture of the pericardiophrenic artery within the chest, especially if the nerve has been roughly withdrawn. To produce a temporary paralysis of the phrenic it may be frozen by ethyl chlorid, injected with 5 per cent. phenol or by alcohol, or crushed (phrenemphrexis). These operations have also been used for convulsive tic or spasm of the diaphragm, from encephalitis or other cause, intractable hiccough, pain from adhesions of the diaphragm, and to prevent bronchiectasis following a postpneumonic fibrosis, or to overcome functional effects due to displacement of the heart from pulmonary fibrosis (Davies). The operation is chiefly used to compress the lung, relieve hemorrhage, prevent aspiration of secretions from the upper portions of the lung into the lower lobes, lessen effusions, facilitate expectoration, and to prevent the stagnation of secretions, especially in the lower lobe.

SPONTANEOUS PROGRESSIVE PNEUMOTHORAX FOLLOWING ARTIFICIAL PNEUMOTHORAX

Case V.—Mrs. G. H., age thirty years, married, nullipara.

Chief Complaint.—Pain in chest, expectoration, hemoptysis, loss of weight, dyspnea.

Previous History.—In 1926 patient was taken with pulmonary hemorrhage, loss of weight, and slight cough. With a diagnosis of pulmonary tuberculosis she entered a Tuberculosis Camp where she improved and was discharged one year later as an arrested case. In 1927 recurrent pulmonary hemorrhages caused her to return to camp where she remained eight months; four months later, after returning home, she had recurrence of the hemorrhages; after four hemorrhages, she returned to camp and artificial pneumothorax was used. During the course of the treatment, the patient suddenly developed tightness and oppression of the chest, dyspnea, rapidity of pulse, and displacement of the heart with tendency to cyanosis and coma. The chest was aspirated and gas removed, but it repeatedly returned. At one time continuous aspiration by an electric pump was used in order to keep the patient alive. The patient became comatose and apparently moribund and her life was saved only by the constant and skilled aspiration used by Dr. McDevitt, who was in charge of the camp. Finally, a surgeon was obtained from a neighboring city who introduced a tube in the seventh intercostal space and the patient was referred to the Samaritan Hospital.

Operation, October 1, 1928.—With resection of 5 cm. of the seventh and eighth ribs the left lung was found largely collapsed; pleura covered by thick exudate, and pus of a fetid odor. The opening in the lung soon closed. Under irrigations with Dakin's solution, and further sanitarium treatment, the opening in the chest spontaneously healed. Since this time, there has been no recurrence of the hemorrhage or pneumothorax and the patient remains free from symptoms.

Comment.—Spontaneous progressive pneumothorax occasionally occurs after crushing injuries of the chest or in the course of pulmonary disease and also has been reported by Cairns after complete paralysis of the diaphragm from operations on the phrenic nerve. It is a very important and, if unrecognized, a very dangerous complication of artificial pneumothorax. The opening from the lung into the pleural cavity may be traumatic, as when the lung is perforated by a needle or a fractured rib, or a rupture may occur through an emphysematous area or be due to an ulcerative process, which perforates the visceral pleura.

On expiration and coughing, air enters the pleural cavity and may progressively compress the lung, displace the mediastinum and heart and finally so compress the opposite lung as to cause apnea, unconsciousness, and death. It is most important to recognize the condition in the early stages, because the patient's life hinges upon the prompt removal of air from the chest as in the case of this patient. If the condition recurs or progresses despite aspiration, thoracostomy and the introduction of a tube into the pleural cavity are required. If infection has not already spread to the pleura from the lung, attempts should be made to remove the drain early and before the development of pyothorax. Often, however, the development of a pleural infection necessitates free and continual drainage. Obviously Dakin's solution or other liquid should not be introduced into the cavity of the chest while there is an opening into the lung.

MUSCULOSPIRAL PALSY FOLLOWING TREATMENT OF MALARIA BY INJECTION OF SODIUM CACODYLATE; EXTENSOR PARALYSIS OF THE FOOT FOLLOWING INJECTION OF ALCOHOL FOR SCIATICA

Case VI.—Mrs. F. F., age fifty-eight years, admitted 4/25/29.

Chief Complaint.—Left wrist-drop from musculospiral paralysis.

Previous History.—On January 2, 1929 a sodium cacodylate injection was made in the lateral surface of the left arm during the course of treatment for malaria; there was an immediate marked contraction of the extensor muscles of the wrist and fingers, followed by paralysis of the extensor muscles of the wrist and hand, and wrist-drop. No sensory involvement has been noted.

Operation, 4/26/29.—Sixteen-cm. lateral midbrachial incision with exposure of the musculospiral nerve; nerve liberated, bundles separated and disassociated for a distance of 11 cm. The nerve was small, not adherent, and without definite thickening of the sheath. In the lower part of the midthird of the arm there was a slight thickening for a distance of 4 to 5 cm. where the nerve-bundles were edematous and obscured. Distinct bundles were found above and below this area. After the hersage the nerve was placed in an intramuscular plane, the wound closed without drainage, and a cock-up splint applied.

May 10, 1929.—Patient is able to extend the fingers and has beginning power of extension of the hand. Faint voluntary contractions of brachioradialis are present.

Case VII.—Mrs. A. A., age fifty years, white, widow.

Chief Complaint.—Pain along sciatic nerve involving the foot.

Previous History.—Four years ago sustained fracture of the right leg below the knee; three months after the fracture sciatica developed. In September, 1927 an injection of alcohol was made in the region of the right sciatic nerve without effect. In November, 1927 the injection was repeated, and was followed by partial relief from pain, but inability to dorsiflex the foot. Examination shows marked wasting and reduced circumference of right thigh and of the muscles below the knee, and complete loss of extensor power of the right foot.

Diagnosis.—Partial interruption of the right sciatic nerve.

Operation, 3/26/29.—Seventeen-cm. posterior median incision from the fold of the buttock on the right thigh downward; sciatic nerve exposed for a distance of 20 cm. The sciatic nerve was not adherent nor changed in diameter. Some degeneration of the bundles was apparent at the level of the fold of the buttock, without intraneural fibrosis. The sheath and two-thirds of the fibers were separated and disassociated for a distance of 12 cm. after moderately stretching the nerve.

Two weeks after operation patient was nearly free from pain, sensation had improved, but she was unable to raise the foot. In June, 1929 evidence of returning motor power was present.

Comment.—Last year we reported a case of musculospiral paralysis following the injection of a solution of quinin and urea into the arm in the treatment of pneumonia. These two additional cases in which peripheral nerve paralysis followed therapeutic injection of drugs are cited as indicating the care that should be taken as to the site of injection of medicinal substances that may have a destructive effect upon the motor nerves. It is important in all cases where the paralysis persists to expose the affected nerve by operation, to open the sheath, free adherent fibers, and place the damaged nerve in a vascular, muscular bed, from which it may acquire a new source of blood-supply. Rarely, the destruction may be so extensive that resection of the nerve and suture may be required.

CLINIC OF DR. CHARLES F. NASSAU

JEFFERSON HOSPITAL

TREATMENT OF GASTRIC AND DUODENAL ULCER

THE institution of proper treatment for gastric and duodenal ulcers depends largely upon whether or not the patient has chosen a surgically minded internist. Medical treatment is advocated chiefly by physicians who specialize in gastro-enterology and these men claim excellent results, particularly in duodenal ulcer and in the non-obstructing type of gastric ulcer.

Having established the presence of ulcer by the clinical symptoms, gastric analysis and *x*-ray studies, it is entirely proper to try a course of medical treatment in duodenal and non-obstructing pyloric ulcers. This must not be too prolonged, however, on account of the possibility of perforation. It must be remembered, too, that ulcers are peculiarly prone to seasonal variations and, therefore, one may be deceived by apparent medical cures, recurrence of symptoms after temporary improvement under medical treatment being very common. Furthermore, while ulcers may heal under medical treatment, in the process of healing a surgical lesion may result, such as pyloric stenosis or hour-glass constriction, the former sometimes occurring in duodenal ulcer, and the latter in gastric ulcer.

After deciding upon the wisdom of medical treatment every possible focus of infection should be eliminated. The percentage of failure to cure in cases treated medically varies from 67.3 per cent. (Balfour) to 57 per cent. (Forman). In view of such figures we must recognize that medical treatment is at present unsatisfactory and that the safest and surest method of cure is surgical.

Pathologically, gastric and duodenal ulcers present somewhat similar processes. Since the practice of subtotal gastrectomy much more has been learned from the gross and micro-

scopic study of specimens than was possible from necropsy material. From a detailed histologic study of a large number of duodenums and stomachs removed at operation there is apparently no evidence that the defect in the mucous membrane depends upon nutritional disturbance. On the contrary, where differentiation is possible, inflammatory mucosal changes predominate as the outstanding microscopic picture.

Many observers speak of gastric and duodenal ulcers as one and attribute their development to extensive infection with points of ulceration and lymphatic infiltration, or to aseptic or mildly infective emboli which involve the smaller vessels and which may present thrombi. True pyloric ulcer is very rare. In a series of 2000 chronic gastric ulcer cases Moynihan reports that less than 3 per cent. of them were at the pylorus or within $1\frac{1}{2}$ inches of it. There are certain fundamental differences between duodenal and gastric ulcers, and the pyloric vein is commonly used as a dividing line. The chemical condition of the stomach is the same in either type of ulcer. In duodenal ulcer perforation and hemorrhage are more frequent, but there is a greater tendency toward malignancy in gastric ulcer. It is still unsettled as to whether the extensive inflammatory changes develop before or after the appearance of the ulcer.

The conception of ulcer formation on the basis of pyloric spasm was first advanced in 1897 by Mikulicz and there is reasonable evidence upon which to base the theory that pyloric spasm may be at least one of the chief causes in the development of both gastric and duodenal ulcers. The frequency of pyloric spasm both in the infant and in the adult is known to every clinician. It interferes with the normal emptying of the stomach and brings about a definite state of gastric retention. Intermittent or continuous spasmodic contractions occur also at other sphincter sites—spasm of the cardia, which produces an esophageal dilation and spasm of the sphincter papilla (sphincter of Oddi) which causes dilation of the common and hepatic ducts. The neurogenic theory as to the cause of the occurrence of ulcers must be ignored, although it is of distinct interest from a surgical viewpoint.

This brief discussion of a few factors which are related to the genesis of gastric and duodenal ulcers is presented as evidence of the unsettled status of the entire problem. Certainly within the last ten years nothing of importance has been added to our knowledge of the etiology of ulcer.

In nearly every case the development of ulcer is found to be the result of a definite inflammatory destruction of the mucosa. In many places the normal surface presents evidence of healed ulceration, but frequently this is limited to the superficial layer. This process is most advanced in the antrum of the stomach and in the duodenal bulb. In brief all cases show more or less advanced chronic gastritis or duodenitis in various stages of development. These are common findings in the hands of most observers.

The appearance successively or simultaneously of two or more ulcers in a patient has been termed clinically spontaneous double ulcer. In from 5 to 10 per cent. of cases ulcers are multiple and in some instances the coexistence of an ulcer in the stomach and in the duodenum is observed in the same specimen.

The surgical treatment has, of course, been commented upon from numerous angles. The variable phases in the treatment depend to some extent upon the etiology of the condition. For some time past there has been a definite tendency toward radical surgery in all ulcers, but since their etiology is so far from being settled the type of operation cannot be standardized. In the light of our present knowledge no attempt should be made to use one certain operation for the treatment of every condition. Only practical experience and clinical results which have been observed over a long period of time can form a basis for rational treatment. The type of operation to be performed depends upon a number of factors of which the most important are the location and character of the ulcer, the general condition of the patient, the possibility of malignancy of the ulcer, and the degree of gastric acidity.

Posterior gastro-enterostomy always has given and, I believe, will continue to give the highest percentage of cures. In the beginning surgeons began to treat these ulcers by gastro-

enterostomy, then turned vigorously to partial gastrectomy and now the pendulum has swung back to gastro-enterostomy. Ulcers at or near the pylorus are readily cured by this procedure. Of all the ulcers which come under the care of the surgeon it is in this condition accompanied by obstruction that he achieves his most brilliant results. In simple ulcer of the duodenum it is better to deal with the ulcer direct and follow by gastro-enterostomy. In cases of healed duodenal or gastric ulcers with constriction of the pylorus, Finney's pyloroplasty has given me most excellent results, and in this type of case pyloroplasty is, I believe, the procedure of choice. The operation must be performed without clamps as their application to the walls of the duodenum is not without danger of necrosis of the bowel, as occurred to me in one patient. It is to be remembered, however, that Finney's pyloroplasty is a much more difficult operation to perform than gastro-enterostomy and should not be attempted by anyone who is unskilled in this type of work.

In the saddle type of ulcer and in ulcers of the lesser curvature, which are occasionally multiple, partial gastric resection is to be preferred in combination with Billroth I if possible technically or, if not, an operation of the Polya type. Simple gastro-enterostomy laid on posteriorly or even anteriorly should not be undertaken after partial gastric resection if it can be avoided. After all, the conscientious surgeon will perform that operation which in his hands exposes the patient to the least possible risk commensurate with the probability of improvement in health. Do not perform an operation upon any patient because it can be done, but rather choose a type of operation suitable to the patient's local and general condition which will give him the best chance of recovery.

The success of gastro-enterostomy depends upon: (1) Removal of foci of infection previous to operation; (2) actual demonstration of an ulcer; (3) careful technic; (4) postoperative care. In competent hands the mortality is now about 1 per cent.

In one series of over 100 gastro-enterostomies there were 90 per cent. of cures. Pyloric exclusion was not used in this series in combination with the gastro-enterostomy. In 1925 Christian

Bull, in a critical discussion of 94 cases with *x*-ray follow-up notes, stated that better results were obtained without pyloric exclusion, and a number of Continental surgeons who formerly added some type of pyloric exclusion to the gastro-enterostomy have long since abandoned it.

Excision of a duodenal ulcer is not made a routine part of the surgical procedure, although occasionally in ulcers of the anterior wall cautery destruction apparently gives excellent results. One must never forget the possibility of reflex spasm of the pylorus from the resultant scar. Bull says that excision of the ulcer gives the least favorable results, most of his patients so treated being recorded as unimproved.

In 1921 Clairmount observed before the German Surgical Congress that there was no great difference in the end-results between gastro-enterostomy and the various types of resection. Bull notes that the results of his operations are always better after gastro-enterostomy than after resection, this with no regard to the localization of the ulcer. On the other hand, Finsterer, who routinely removes the greater part of the stomach in both gastric and duodenal ulcers, claims clinical cures in all of his cases. It is difficult to reconcile these opposing statements except by one's own experience, but I feel very strongly indeed that we have no right to expose a patient to the higher mortality of a gastric resection when a much safer procedure will accomplish the same end.

The outstanding complication of gastro-enterostomy is the development of gastrojejunal ulcer. This crippling lesion has caused a considerable number of surgeons to adopt partial gastrectomy as the operation of choice in all gastric and duodenal ulcers. While the mortality of partial gastrectomy is surprisingly low and the immediate results most satisfactory, the incidence of gastrojejunal ulcer is not absolutely eliminated and the operation is not without other dangers. If the occurrence of jejunal ulcers is dependent upon acidity, at least two-thirds of the stomach must be removed at operation. Radasch, in a study of the histology of the stomach, found that the acid cells began at the cardiac end of the stomach and extended for about

two-thirds of the distance of the lesser curvature and three-fourths of the distance of the greater curvature, ending in a very sharp line at the above points. If a partial gastrectomy be performed in order to produce a certain anacidity the greater part of the stomach must be resected.

Figures on the postoperative development of jejunal ulcers vary from that of the Massachusetts General Hospital which reports 1.7 per cent. jejunal ulcers, to Berg and Lewisohn who record 25 per cent. jejunal ulcers. Moynihan reports 3 to 4 per cent. In my own practice I doubt that more than 2 per cent. develop jejunal ulcers.

The treatment of gastrojejunal ulcer consists of a gastrectomy beyond the point of anastomosis and reanastomosing the jejunum to the stomach. Finsterer recently has given up the anastomosis of Roux, because of two recurrences following the latter type of operation.

It has been generally assumed that gastrojejunal ulcers do not occur after partial gastrectomy but there are reports appearing that resection of the stomach does not entirely eliminate this hazard. Probably the incidence of jejunal ulceration is less after resection than after gastro-enterostomy. Walton reports 2 cases following partial gastrectomy by other surgeons and similar incidents are reported by Beer. Von Haberer has abandoned the Billroth II in favor of Billroth I, as he found gastrojejunal ulceration so common after the former operation. Wright reports 2 similar cases and notes that up to the present time gastric resection has been reserved for gastric carcinoma. It is only in recent years that partial gastrectomy has been carried out in the treatment of peptic ulcers, and jejunal ulcers are now beginning to appear. Walton states there is doubt that this serious complication is entirely eliminated by the substitution of the more dangerous resection. Finsterer mentioned seven gastrojejunal ulcers following partial gastrectomies which had been performed by other surgeons.

Gastrojejunal ulcers predominate in the male and are most commonly observed after pyloric and duodenal ulcers. Mandel and Holbaum have never observed such an ulcer following an

ulcer of the middle of the stomach. In Walton's series of 20 cases, only one gastrojejunal ulcer developed after an ulcer of the lesser curvature and this instance was associated with a very high gastric acidity.

An interesting article by Allen in the American Journal of Surgery, 1928, which discusses postoperative jejunal ulcer, says that the cause of ulcers near the suture lines after gastro-enterostomy is unknown. Many theories based upon mechanical considerations have been advanced, among which are the use of clamps, non-absorbable suture material, too small a stoma or one not well placed, an infected hematoma in the suture line, focal infection, and operation performed in the absence of a pathologic lesion. Allen reports 4 cases that showed the tendency of certain persons to develop ulcers regardless of the procedure used, and I have one interesting case of my own.

In 1913 I saw a patient, a man fifty-two years old, who gave the following history. Within a period of less than a year he had lost nearly 50 pounds in weight. Vomiting was increasingly frequent and he had marked retention of food in the stomach. The *x*-ray report showed "complete basin-shaped retention, as late as twenty-four hours, in a large, dilated, prolapsed stomach." Abdominal palpation was easy owing to his extreme emaciation and a large mass was felt in the region of the pylorus. I made a preoperative diagnosis of carcinoma of the stomach and operated upon him on May 1, 1913. The entire pyloric end of the stomach was occupied by an immense mass approximately 6 x 9 cm. and so fixed as to be immovable. A short loop posterior gastro-enterostomy was made and the patient had an extraordinarily easy convalescence. On August 1, 1913, he reported at my office saying that he was feeling fine, was able to eat and digest practically everything, and that he had almost reached his normal weight of 180 pounds.

I heard from him both directly and indirectly over a period of years, and in 1918 follow-up fluoroscopic study showed that the gastro-enterostomy opening was functioning satisfactorily. There was no evidence of narrowing or tender areas. The pylorus was closed.

The patient remained entirely well until February, 1923, when he began to have a return of symptoms which were to some extent relieved by the use of alkalis. The general examination was entirely negative. *x*-Ray examination showed a jejunal constriction near the gastro-enterostomy opening with marked localized tenderness. The diagnosis was obstructing jejunal ulcer.

At operation, July, 1923, the abdomen was opened through the old scar. After the release of numerous adhesions, the opening of the gastro-enterostomy was brought into view. The stoma was occupied by a huge ulcer in which the jejunum was involved to a far greater extent than the stomach, and which extended over a considerable area. The stomach wall had a comparatively small amount of involvement. By using part of the stomach wall to repair the jejunum the anastomosis was released and the stomach and jejunum securely closed. A resection of the diseased jejunum was out of the question on account of the involvement of the wall of the small bowel which continued up to its emergence through the transverse mesocolon.

At this point in the operation an inspection was made of the pyloric end of the stomach, and here a curious condition was found. During the healing of the original ulcer an almost total obliteration of the pylorus had taken place over a distance of slightly more than 6 cm. There remained only a narrow, mucous membrane-lined tube through which it would not have been possible to introduce anything larger than a lemonade straw. I was, therefore, immediately concerned with the necessity of remedying this defect as the gastro-enterostomy had just been disconnected. The simplest and most obvious procedure was the performance of a Finney's pyloroplasty, which was done as rapidly as possible, owing to the extremely weak condition of the patient.

An ideal convalescence followed, free from complications of any kind, and the patient left the hospital in August, 1923. He remained well until December, 1927, when he was again admitted to the hospital complaining of vomiting. *x*-Ray examination showed an obstructive lesion at the pylorus. He had

almost complete gastric retention at twenty-four hours. Physical examination was negative; no mass was palpable.

Operation under morphin-scopolamin and nitrous oxid anesthesia, December, 1927. The abdomen was opened through the upper left rectus muscle as I wished to avoid having to separate adhesions in the twice previously opened abdominal wall. The stomach was very large. A large mass (ulcer) was found at the pyloric end of the stomach, involving a portion of the stomach and the duodenum as well. The condition was almost the same as that found at the first operation. Without the use of clamps, an anterior gastro-enterostomy with the long loop was made and an entero-enterostomy laid on the loop leading from the gastro-enterostomy at a point 4 inches from the beginning of the jejunum, and at as low a level as possible. Convalescence was again normal and he was discharged on January 15, 1928, in most excellent condition.

He has remained well up to the present time, is eating normally, and has no gastric distress. If he should develop another ulcer it is difficult to say what further procedure could be undertaken, unless the mass at the pyloric extremity of the stomach has again disappeared and conditions lend themselves to a resection of at least the right half of the stomach.

Partial gastrectomy is seldom if ever indicated in duodenal ulcer and is indicated in gastric ulcer chiefly because of the danger of malignant degeneration.

It is interesting to see from time to time reports on the number of recurring ulcers following partial gastrectomy. In the Annals of Surgery last year Balfour reported 28 ulcers following partial gastrectomy found at subsequent operation. In 14 cases the ulcer followed resection for gastric ulcer, in 8 cases resection for reactivated duodenal ulcer following other operations and in 6 cases resection for gastrojejunal ulceration. Classifying the lesions according to operation 3 followed resection of the Billroth I type; 6 followed resection of the Billroth II type; 10 followed sleeve resection, 7 a Polya operation of the posterior end-to-side type, and 2 followed resection completed as an anterior end-to-side gastrojejunostomy. Balfour

says that the cause of these recurrences cannot be established since recurrence takes place when every known factor has been eliminated.

Hurst puts special stress upon the late complications which follow partial gastrectomy and has even claimed that it may be followed by pernicious anemia. He states that he knows of 5 such cases where this complication occurred. He also says that there is in literature 100 cases of secondary ulcer after partial gastrectomy. Whether or not these claims will be substantiated it is evident that removal of large portions of healthy stomach may be followed in the future by grave complications. In spite of statistical evidence which shows a very low mortality in the hands of the skilful surgeon. Walton says that the mortality in partial gastrectomy will be higher than the combined mortality of gastro-enterostomy and the incidence of gastrojejunal ulcer after such an operation, and the follow-up in this type of operation for duodenal ulcers shows no better general results than posterior gastro-enterostomy.

The symptoms of recurrent ulcer parallel those of primary ulcer in one important respect. Pain, regardless of its situation radiation, or spread, is related to the ingestion of food, although I had one patient in whom the ingestion of food had no effect upon the pain, which was absent when he was lying upon his back. In the erect position, however, pain was persistent and was accompanied by diarrhea.

Considerable variation of opinion is expressed by able observers concerning the possibility of malignant change in an existing ulcer. Von Haberer states that it occurs in 5 per cent. of cases and other opinions vary from practically negative to as high as 30 per cent. Cole states that the grafting of malignancy on a previous ulcer is a most unusual event, basing this opinion upon the result of continued *x*-ray studies.

TECHNIC OF OPERATION

General anesthesia should be avoided, although unquestionably there are some patients who are in such excellent condition that the usual operation under skilfully given ether or nitrous

oxid and oxygen may be well borne, but it is not the method of choice if some other form of anesthesia can be successfully employed. With the newer developments in spinal anesthesia, which make it apparently a safe procedure, most posterior gastroenterostomies can well be carried out in the limited time given by this form of anesthesia. However, if the question of gastric resection must be considered, splanchnic anesthesia by the method of Braun should be used in preference to any form of inhalation. As a matter of fact, with the help of carefully administered morphin and scopolamin, a large number of individuals will require nothing more than local anesthesia of the abdominal wall.

Use a right pararectus incision, and first inspect the gallbladder and appendix. If the ulcer be not readily found, open the lesser peritoneal cavity. Inflammatory changes are not uncommon here and it is possible to overlook an ulcer on the posterior surface of the stomach unless this is made a part of the surgical procedure. Usually the exposure of the bursa omentalis is most easily effected through the gastrocolic omentum; occasionally adhesions make it difficult.

The incision in the mesocolon should be made as close as possible to the vertebral column. The edges of the mesocolon are fixed to the stomach by a number of sutures before the anastomosis is begun. Either fine silk or fine chromic catgut is used for the peritoneal approximation. Personally, I feel that it is safer to use silk for the peritoneal suture and hard tanned catgut, size 0, with the needle swedged upon the end of the suture, for the inner layers. Care must be taken to bring about absolute apposition of the mucous coat, so that no gap remains between the stitches. If the mucous membrane of the stomach is very redundant at the opening a small strip may be excised.

In recent years I have not been doing a strictly no-loop operation in pyloric and duodenal ulcers, but place the opening 2 or 3 inches from the duodenojejunal flexure. The experience of operating upon a number of gastrojejunal ulcer cases where the no-loop operation had been the primary procedure led me to abandon the strictly no-loop operation. No ill-effect has been

noted since adopting the use of a 2- or 3-inch loop. Walton believes that we have been obsessed with the idea of the value of the no-loop anatomosis owing to the evil effect which unquestionably follows the use of a very long loop. The stoma is placed from right to left, from the greater curvature upward toward the left. The distal end of the jejunum is approximated to the greater curvature. The anastomotic opening is usually made 3 to 3½ inches from the pylorus.

In the technic of resection the most important step is the satisfactory mobilization of the stomach. As a rule the removal of the stomach is begun at the duodenal end. It is important that the line of resection be carried out in normal stomach wall. The duodenum is crushed with Payr's clamp, a silk ligature tied in the groove, and the end inverted with interrupted sutures, preferably of the mattress variety. It is important also in the inversion of the duodenum to effect its closure in healthy tissue; if necessary, a part of the stomach even proximal to the pylorus may be utilized for the site of the inversion. Occasionally one is able to approximate the lumen of the stomach and duodenum without tension; in this case continuity is re-established by the Billroth I, but usually a dangerous angle is formed and the suturing is insecure. When possible the resection is completed by anastomosis of the entire end or the lower half of the transverse section of the stomach to a short retrocolically placed jejunal loop.

POSTOPERATIVE TREATMENT

Following either gastro-enterostomy or resection the patient is given a Murphy drip, and, if indicated, subcutaneous introduction of salt solution, either at eight- or twelve-hour intervals, or continuous hypodermoclysis, this depending upon the condition of the patient. Transfusion is resorted to if necessary. Morphin in small doses should be given if pain and discomfort are marked during the first twenty-four hours.

The use of ice or milk, unless peptonized, is absolutely interdicted as a part of the postoperative treatment. In the absence of nausea or vomiting, hourly doses of hot water or tea are administered at the end of the sixth hour, so that the patient

in the course of a day receives about 200 c.c. of fluid. This restriction of fluids by mouth is compensated by rectal and subcutaneous injection. From the third to the fifth day the quantity of fluids is increased. On the third day broiled steak may be chewed and the pulp rejected with extremely beneficial results. This brings about all physiologic processes and is, therefore, superior to the ingestion of broth or beef tea. On the fifth or sixth day, I begin with soft pulpy food.

Gastric lavage is occasionally necessary if nausea or vomiting persists. The fluid obtained is often blood tinged, which may have its source from the suture line or in a remaining ulcer. It is often possible to avoid the use of gastric lavage by the administration of a Seidlitz powder; if the latter fails to afford relief, resort is then made to the stomach-tube. The lavage must be carried out under low pressure and only a small quantity of fluid (200 to 400 c.c.) used. This is well tolerated and the result most gratifying. I have seen no adverse effect of its use in my experience.

If the operation of gastro-enterostomy could be avoided and a simpler method used by means of which the healing of the ulcer might be achieved with certainty and without future complications we should undoubtedly obtain a tremendous improvement over our present postoperative results. In line with this thought, within the last year or so both in this country and abroad, a few surgeons have been trying out an operation which consists of partial excision of the pyloric sphincter; in other words, a glorified adult Rammstedt operation. As yet, however, no one has used this procedure in a sufficient number of cases or over a long enough period of time to be able to arrive at any conclusions concerning its real value.

The surgery used in the treatment of gastric and pyloric ulcers should always be made as safe and as simple as is possible and it is my feeling that, except in instances noted under certain types of gastric ulcer, a gastro-enterostomy offers the patient the greatest hope of cure at minimum risk. While it is not a panacea, the mortality is low, the results are certain in the majority of chronic pyloric and duodenal ulcers, and patients remain well as they are followed from year to year.

CLINIC OF DR. T. TURNER THOMAS

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PRIMARY CLOSURE OF THE WOUND IN COMPOUND FRACTURES

THE immediate closure without drainage, except between the skin sutures, of the ordinary compound fracture, especially that with a small wound of the skin over the seat of fracture not larger than could be accounted for by the protrusion of a fragment of the fracture and usually with no bruising or other sign of direct trauma, is justified by the results in the writer's experience. A presentation of this view with cases to support it was read before the American Medical Association and published in the Journal of the Association on August 5, 1922. A few selected cases will be offered here from the writer's experience since that time. He believes that most fractures are due to indirect violence, compound as well as simple fractures, and that the compounding wound is nearly always due to the protrusion of a fragment of the fracture through the skin. The 2 cases involving the femur, here reported, were probably due to direct violence, but the compounding wound in both was probably due to the protrusion of a fragment.

The general tendency has been to agree with the view that "All compound fractures are potentially infected." The writer prefers to consider that nearly all of them are potentially clean, that what we have to control is a small amount of infection picked up by the protruding fragment and the small wound. Though the wound is usually small in the skin, it increases in size toward the site of fracture where it is usually very extensive, due to the forcing apart of the fragments immediately following the fracture when one of them is being thrust through the skin. The small amount of infection unless quickly and effectively con-

trolled will soon involve the whole cavity. To swab out the whole wound cavity with tincture of iodin may be unnecessarily severe treatment, but the writer has been using it for about ten years and has had no trouble from it and does not have as much confidence in the effectiveness of any less severe antiseptic. Its irritability is much neutralized by following it with alcohol.

The thoroughness of the fragment immobilization plays an important part in the healing of the wound in a compound fracture or in the open treatment of simple fractures. Perfect immobilization is practically impossible even by plates and screws. Powerful muscles tend to move the fragments on each other often against plate and screw fixation and sometimes loosen the screws, bend or break the plate, with a breaking down of the wound which is aggravated as the loosening of the fragments increases. Plates and screws are used almost exclusively in operations upon fractures of the compact shafts of the long bones and the screws are commonly made to pass through only to the medullary cavity, *i. e.*, through one layer of the compact bone. A more firm fixation is obtained when they go through the whole bone, *i. e.*, both layers of compact bone and the medullary cavity. Disinfection of the wound and immobilization of the fragments are the most important factors in the treatment of compound fractures.

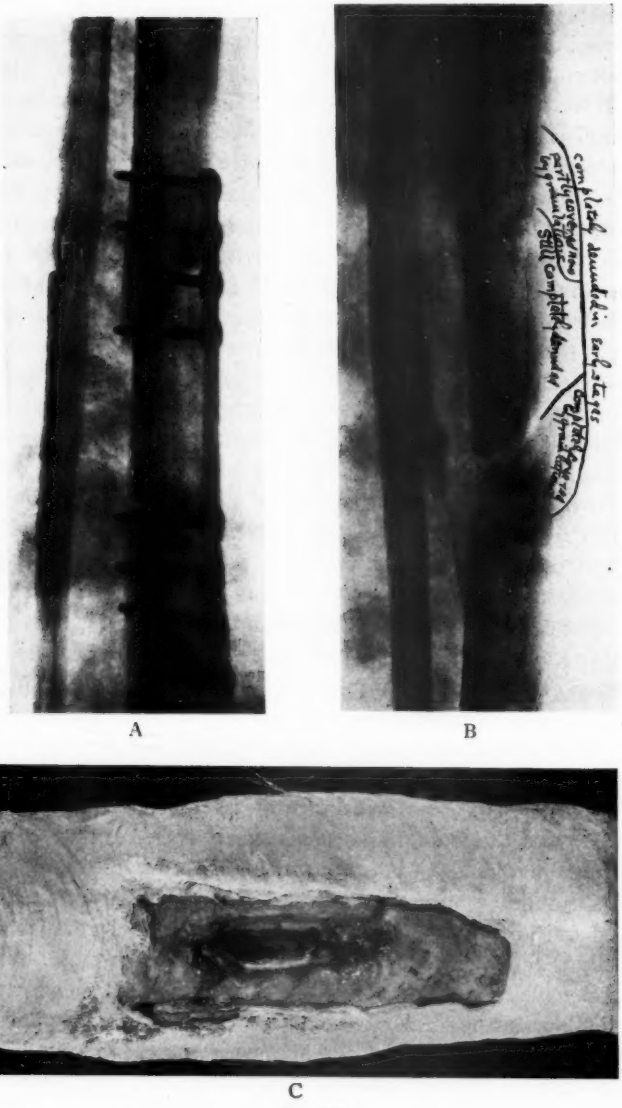
While plate and screw fixation is the firmest it is not without its objections. The most common compound fracture is that of both bones of the leg, *i. e.*, the fracture involves both bones, but usually only the fracture of the tibia is compound. This is explained by the ease with which a tibial fragment perforates the thin overlying tissue. The writer has found this the most difficult in which to obtain primary healing of the operation wound, but believes this is due to something more than infection per se. The soft tissues, muscles, fascia, and skin are normally just long enough to accommodate the length of the bones. Contraction of the muscles from the fracture irritation causes the bones to shorten as well as all the remaining surrounding soft structures. These become more or less rigidly infiltrated by blood and the products of the reparative inflammation, so

that they then offer a substantial resistance to the lengthening of the limb necessary to permit the fragments to become accurately replaced.

If one applies sufficient traction for immediate complete reduction by the closed method the effect of this resistance may become visible in a whiteness of the skin in some areas, indicating impaired circulation. This will usually disappear soon if the traction is maintained, but in one of the writer's compound fractures[1] reduced by the closed method a large area of skin and subcutaneous tissue sloughed away, complicating the healing greatly and resulting in considerable permanent deformity. This led to the use of the open methods in succeeding cases which developed somewhat similar troubles. After accurate reduction and fixation of the fragments on attempting to close the wound one finds that considerable tension must be applied by the sutures. The incision is made in the thin, poorly nourished tissues overlying the tibia deprived of some of its nourishment further by detachment from the tibia for exposure and application of the plates and screws. Not infrequently on tying the skin sutures the immediately surrounding skin becomes pale from the effect of the suture tension on the circulation. Without local or constitutional signs of infection the sutures tend to cut through the tissues, the wound margins to gape, and the plate, screws, and fragment surface to become exposed. The open wound thus created usually takes a long time to close, often months.

But there is a very important difference between this breaking down of the wound and that commonly seen in compound fractures in which the infection invades the whole fracture line and surrounding wound and tends to invade the surrounding tissue and form sinuses behind and at the sides of the limb which usually take many months and sometimes years to close. This wound remains a superficial one, *i. e.*, from the anterior surface of the bone to the skin. The soft structures posteriorly and at the sides are adherent to the bone everywhere, no wound discharge coming from the fracture line, the sides of the fragments,

[1] Jour. Amer. Med. Assoc., August 5, 1922, p. 453.



A B C

Fig. 395.

or from the screw holes. The fracture line soon fills with granulation tissue as do the holes left by the removal of the screws.

We are not dealing here so much with an infection as with a necrosis of the superficial poorly nourished tissues, and most of the dangers and difficulties of compound fractures have been overcome. Traction does not provide as good reduction or fixation of the fragment, but in compound fractures of the leg is not associated with as much necrosis. The overlying thin, poorly nourished tissues maintain the circulation derived through their undisturbed adhesion to the tibial surface. The degree of immobilization of the fragments varies with the degree of traction applied. The degree of its continuity is also important. The only kind of traction employed by the writer, with the exception of the case involving the shaft of the humerus, is that obtained by his traction cast, described and illustrated for fractures of the leg in the issue of this publication for February, 1921. Space forbids a repetition of this description. Traction by a Jones splint was very successful in the compound fracture of the humerus (see Case II).

The following cases have been selected to illustrate the value in compound fractures of disinfection of the wound and immobilization of the fragments.

Case I.—Compound Double Fracture of the Leg: Plated.—In the SURGICAL CLINICS OF NORTH AMERICA for February, 1923, the writer reported a case of compound fracture of the leg, which was plated within an hour after the accident and closed without drainage. There had been two fractures of the tibia 3 or 4 inches apart, the intervening fragment being completely detached during the operation and replaced as a graft. It was fixed to the two main

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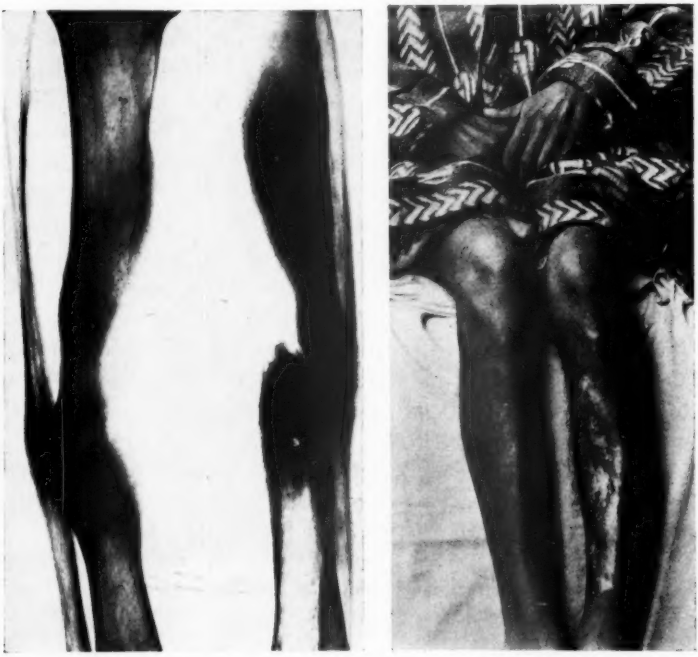
Fig. 395.—Case I. A, Lateral view of the double fracture of the tibia and single fracture of the fibula, fixed by a Lane plate and eight long screws in the tibia, two screws in the middle fragment, and three in each of the main fragments. B, Same view five months after the accident. The anterior surface of the middle fragment was still completely bare of granulations, the upper fragment partly covered, and the lower fragment completely covered by granulations. C, A photograph of the wound five months after the accident, seen through a hole in the cast. The middle fragment is seen to be completely bare of granulations.

fragments by a Lane plate and eight screws (Fig. 395, A). The accident occurred in the street and the patient wore the soiled working clothes of a mill hand, the compounding wound being soiled and bleeding freely. The grafted fragment became adherent to the adjacent soft tissues everywhere except on its anterior surface where the wound margins became necrotic and left this surface completely bare. Because its only nourishment came through



A B C

Fig. 396.—Case I. These *x*-rays and photograph were made on May 29, 1929. A, Anteroposterior view. B, Lateral view. C, Recent photograph showing healed scar in left leg. The 1-inch shortening in the affected leg is to be accounted for probably by the refracture on July 6, 1923, the slight curvature and some contraction of the grafted fragment during the period of change in it.

its newly developed adhesions on only three sides the progress of the healing was very slow.

The chief interest in the case concerns the fate of this grafted fragment in the presence of so much soiling of the wound. There has never been any evidence of infection posterior to the anterior surface of the bone and none above

it in the surrounding skin and subcutaneous tissue. The completely detached fragment could hardly have lived in an infected wound cavity. At least any pus developing from infection would have gravitated to the depth of the wound and formed sinuses for its escape alongside the bone, at the fracture lines, or screw holes, or burrowed through the soft tissues and skin behind or at the sides of the leg. The opening of the wound anteriorly was due almost if not entirely to necrosis from tension on the sutures of the normally poorly nourished skin and subcutaneous tissue of the wound margins, the circulation of which was made poorer by its detachment from the bone.

The original accident occurred on 8/5/22 and the last note recorded in the above report was made on 1/6/23. On 7/6/23 while standing in a trolley car the patient sustained a refracture at the line of union of the lower end of the grafted middle fragment. On 7/23/23, eleven months after the accident and operation, the surface of this fragment remaining completely bare and exposed, it was decided to explore concerning its vitality. The anterior third in its whole length was pried away by several chisels applied at different points. When sawed through transversely it showed almost normal hardness and none of the appearances of necrosis. At the freshly separated surfaces it showed considerable but not normal vascularity. This was clearly a fracture and in no sense a line of separation due to an effort at sequestration.

6/19/28: Patient says the wound ceased to discharge about two years ago. Has not worn a brace for about three years. Has slight stiffness of the ankle, but practically none at the knee. There is 1-inch shortening of the affected limb.

Case II.—Single Compound Fracture of Leg with Torn Muscle-tendons: Plated.—A twenty-eight-year-old man on 11/9/22 at 8 P. M. was knocked down by a taxicab, sustaining a compound fracture of the lower fourth of the right leg. Brought immediately to the Northeastern Hospital where the leg was cleansed, the wound swabbed with tincture of iodin and alcohol, a sterile dressing applied, and the leg immobilized. There was a wound almost transverse, about ¾ inch external to the tibia and bleeding freely. On the following day an *x*-ray was taken and operation performed with the same iodin-alcohol technic as in the above case. Two tendons with considerable muscle attached to each had been divided completely at the compounding wound evidently by the protruding fragment and the lower ends of these tendons had retracted markedly downward, about 3 inches. Their cut upper and lower ends could not be approximated, and catgut sutures were used to bridge the gaps between them. After swabbing out the wound with dichloramin-T it was closed completely without drainage. The skin and subcutaneous tissue could be approximated only with much tension, which threatened the healing of the wound. A sterile gauze dressing wet with alcohol was applied to the wound and a plaster cast to the limb from the middle of the thigh to and including the foot.

No signs of infection until the thirteenth day when pain was complained of, the temperature rising to 100.8° F., pulse to 82. Cast removed on following day. Pus escaped from upper and lower ends of the wound, but there was no edema or redness. The lower opening was at the site of the compounding wound where some of the divided tendons were sloughing away. Three

days later the whole wound was opened. The lines of fracture are completely filled by healthy granulation tissue and no pus comes from them or any of the

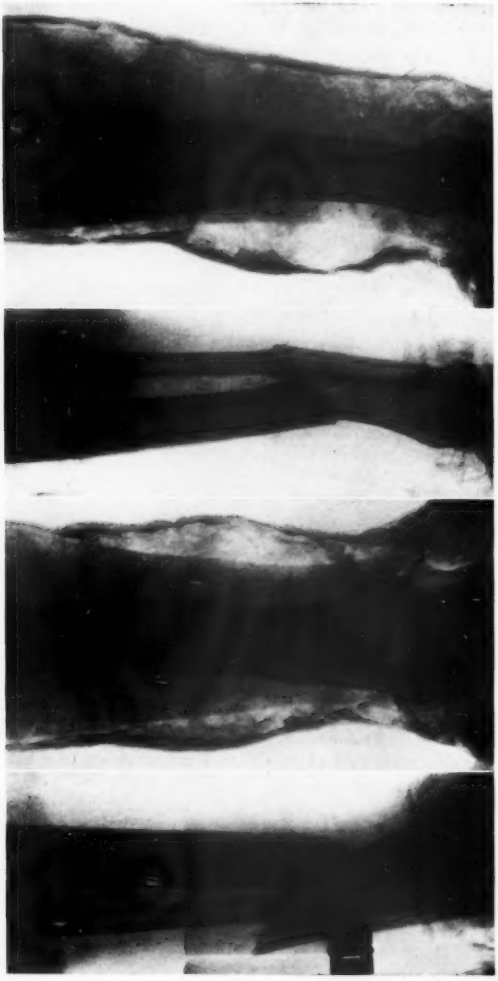


Fig. 397.—Case III. A, Anteroposterior view before reduction. B, After reduction. C, Lateral view before reduction. D, After reduction. Note in B and D the evidence of the dressing between the cast and the leg.

screw holes or from the depths at the sides of the fragments. The discharge that is coming from the superficial wound is not free, and one has no fear of infec-

tion. Plate and screws removed forty days after operation. No evidence of callus at line of fractures. Four days later it was seen that the upper fragment projected forward about ¼ inch on the lower, indicating nonunion. Second cast like the first applied. Returned to work on 6/14/23 with firm bony union, but surface wound not quite healed.

Case III.—Compound Single Fracture of Leg: Fixation by Traction.—Man, twenty-five years old, knocked down in street by automobile, sustaining a compound fracture of the right leg, the wound being in the usual situation over the antero-internal surface of the tibia and about 1½ inches long. Admitted to the Northern Liberties Hospital soon after the accident on 3/25/28. Surrounding skin cleansed with tincture of green soap and water, the wound painted with tincture of iodin followed by alcohol, and dressed with alcohol-moistened aseptic gauze. First portion of traction cast applied.

3/26: Surrounding skin again cleansed, painted with iodin followed by alcohol, and draped with sterile sheets and towels as for the ordinary aseptic operation. The wound then was as thoroughly swabbed as possible everywhere with iodin followed by alcohol. Sterile gauze wet with alcohol applied to the wound followed by more dry gauze and bandage. By traction and manipulation the fracture was reduced (Fig. 397) and the traction maintained by uniting the portions of the cast by more plaster bandages, thus maintaining the traction. A large window was cut in the cast over the wound down to the bandages, but not exposing the wound.

For about a week the temperature varied from normal to about 102° F., and the pulse from 90 to 110, and remained practically normal afterward. Permitted out of bed on 4/7. First cast removed on 4/17, no infection of the wound being present. New cast applied. Discharged on 4/24 in the cast.

Readmitted 6/19/28 on account of bending of both bones at the seat of fracture. 6/20: An osteotomy was done with straightening of the bones, aseptic dressing of the wound and a new cast. Discharged 7/5/28. Cast removed about eight weeks after last operation. No further trouble from bending.

Case IV.—Almost Identical with Case III in Type, Treatment, and Results.—A seventeen-year-old youth on 6/7/29 sustained a compound fracture of the leg with an anterior transverse wound about 1½ inches long, slightly curved downward. The same treatment of the wound with complete inclosure in a traction cast without drainage was employed as in Case III, and to date with the same good results (Fig. 398).

As between open reduction and plating as in Cases I and II, and closed reduction and fixation by traction as in Cases III and IV, the writer feels that in his experience the closed method has demonstrated its superiority. In another case now almost completely healed about eight months after the accident, the compounding wound, as in practically all cases, was over the antero-

internal subcutaneous surface of the tibia and so long that very little extension of it at both ends was necessary to permit the open method with plate and screw fixation to be employed. In a similar case in the future the writer believes he would employ the closed method as in Cases III and IV, and close the wound by suture after the reduction and fixation. Except for the slow healing of the superficial wound the results in this case were as good as in any of the above four leg cases.

A B C D

Fig. 398.—Case IV. A case essentially similar to Case III in all respects. A and C, Anteroposterior and lateral views by *x*-ray before reduction. B and D, After reduction.

As between the open and closed methods in compound fractures of the femur, as employed in Cases VI and VII, the writer would be inclined to use the open method in fractures of the shaft without troublesome comminution as in Case VII, but the closed method as in Case VI, where there is much comminution, especially near the joints. Hard and fast rules, however, should not be laid down.

Case V.—Compound Comminuted Fracture of Lower Third of Leg into Ankle-joint. Gas Gangrene.—On 4/30/23 a twenty-seven-year-old negro laborer fell from a second story window to the ground, sustaining a compound and much comminuted fracture of the right leg into the ankle-joint. He was

brought immediately to the Northeastern Hospital where an intern cleansed the wound and applied tincture of iodin, and a sterile gauze dressing wet with alcohol, but made no attempt to disinfect the interior of the wound nor to reduce the fragment protruding by its whole thickness. There was a wound over the tibia anteriorly about 1½ inches long and 1 inch wide, bleeding freely with torn muscle protruding. There was a second smaller wound on the fibular side about 4 inches above the ankle and nearly over the fracture of the fibula.

He was admitted to the hospital about 11 A. M. and operated on about 12 M. First part of traction cast applied was sufficiently hardened in about a half hour to proceed. Patient was then etherized. Wound and surrounding skin cleansed with green soap and water, washed with ether, swabbed with tincture of iodin followed by alcohol and the whole field of operation draped with sterile sheets and towels. The interior of the wound was then thoroughly swabbed with the iodin and alcohol several times. The fracture was then reduced by traction between the two movable parts of the cast and direct manipulation of the fragments visible through the wound, three silkworm gut sutures were used to stop troublesome hemorrhage, sterile gauze wet with alcohol was applied to the wound followed by more gauze and bandage, and the traction maintained by completion of the cast.

5/1: Temperature since yesterday rose to 102° F. and pulse to 128. Patient had much pain last night, but has little today.

5/2: Highest temperature since yesterday was 101 ° F., pulse 130. A hole cut in cast and wound exposed. Silkworm gut sutures removed. A few bubbles of gas escaped. Torn muscle is seen in wound opening made by removal of sutures. No evidence of infection in wound or surrounding skin which was well exposed. The skin looked normal, had the same color and feel as the surrounding skin, and was freely movable on the underlying subcutaneous tissue with no infiltration or induration. Toes not swollen and patient does not complain of more than the usual discomfort from such an injury. Having no previous experience with the condition suggested by the gas bubbles the writer concluded to apply more tincture of iodin as deeply as possible in the open wound, an alcohol sterile gauze dressing, and wait until the following morning.

5/3: Change in color of skin around the wound, being distinctly blacker than the normal skin and infiltrated varying distances from the wound and under the cast in front and below. Cast removed as quickly as possible. Infiltration extended as far as ankle and upper part of calf and there was considerable odor. Taken to operating room and a guillotine amputation done in lower fourth of thigh. On the following day all signs of sepsis had subsided and the after-course was uneventful. Discharged 6/13 with a narrow granulating surface about 1 inch long and ½ inch wide, about 2 inches more of the femur having been removed on 6/1.

Case VI.—Compound Comminuted Fracture of Femur into Knee-joint from Direct Violence.—On 2/4/24 a forty-year-old factory hand was struck above the right knee by a portion of a bursting rapidly revolving wheel ("whizzer"). He was brought immediately to the Northeastern Hospital. He had on a poorly applied cloth tourniquet about the middle of the thigh

over his torn working trousers and underwear much soiled by dirt and blood. There was a wound on the antero-external aspect of the limb, beginning above the patella and extending obliquely from about 3 inches to the inner side of it downward and outward about 5 inches. It extended through the quadriceps extensor muscle and synovial membrane freely opening the knee-joint, the joint surface of the femur being freely exposed to view.

A rubber-tube tourniquet applied directly to the skin above the cloth one already on controlled a considerable hemorrhage which had continued and the patient was taken to the operating room. After shaving and cleans-

Fig. 399.—Case VI. Compound comminuted fracture of right femur into knee-joint from direct violence, showing conditions present five years and four months after the accident.

ing with tincture of green soap and water the surrounding skin the limb was draped with sterile sheets and towels. The skin was washed first with ether and then swabbed with tincture of iodin followed by alcohol, and more towels applied. The interior of the wound was then thoroughly swabbed everywhere by iodin and alcohol including the knee-joint as far as it could be reached. The interior of the wound and knee-joint were then explored by the finger as far as it would reach, the margins of the wound being strongly retracted. Through the large wound which opened up the knee-joint freely by inspection and palpation it was evident that what now appears as the single lower fragment (Fig. 399) had been crushed or broken up into many small fragments. The original *x*-ray films, now destroyed, showed this vaguely, the numerous

small fragments being held together by the periosteum and the adherent surrounding tissues in the general form of the femur. Strong traction was now applied by the traction cast and brought the very numerous small fragments into a fair resemblance of the normal femur as determined by the palpating finger.

After swabbing the whole interior of the wound with dichloramin-T, the torn margins of the quadriceps muscle were approximated by chromic catgut and the skin by silkworm gut completely except for a superficial drainage tube in the lower part of the wound introduced only to the subcutaneous tissues. Alcohol sterile gauze dressings and bandage to the wound. A plaster cast connected the upper and lower parts of the traction cast and covered the whole limb except directly over the wound. The severe direct violence indicated by the shattering of the bone and the soiled conditions about the wound promised that a severe infection would follow.

2/6: Much oozing into dressings which are removed. No local or constitutional signs of infection. Drainage tube removed. 2/8: Redressing. Much discharge of serosanguineous fluid. No evidence of infection. 2/13: Redressing. A few loose pieces of bone escaped from the wound. A smear of the yellowish discharge showed many polymorphonuclear cells with a few short chain streptococci. No clinical signs of infection. 2/18: There is an opening in the wound just above its lower angle discharging freely a purulent material, but there is no other evidence of infection. Skin sutures removed. 3/6: Cast removed and *x*-ray taken today showed somewhat more angulation than immediately after application of cast. New cast without traction on femur, but an effort made to obtain better alignment of fragments under ether. Finger in wound found the cavity very limited in size, but touched denuded bone. 5/15: Discharged on crutches with sinus open.

Readmitted 2/8/25. A dependent drainage opening had previously been made in outer side of popliteal space. Now a 5-inch longitudinal incision was made here to the bone, in which was an opening leading to a considerable cavity, which was curetted and drained by a tube and gauze. 5/10/29: Has been doing the same work as when first injured for more than a year. All discharge from the wound ceased about three years ago or about two and a half years after the accident. Now has bony ankylosis of the knee in the straight position (Fig. 399), and $1\frac{3}{4}$-inch shortening of the affected limb.

Case VII.—Compound Fracture of Femur: Plated.—On 4/3/29 a forty-year-old stevedore while working in the hold of a ship was struck above the right patella by a group of steel plates swinging horizontally from a crane or derrick. The plates were $\frac{1}{4}$ inch thick and 6 by 10 feet wide and long, 10 of them being bound together. Free hemorrhage began at once and he was brought to the Northeastern Hospital. Had chancre in 1927 and was treated one and a half years in a large Philadelphia hospital and eight months ago was declared negative (Wassermann) in another large hospital.

On the anterior surface of the right thigh about 4 inches above the patella is a transverse wound about 1 inch long. Extending from it medially about 3 inches and laterally 1 inch through the wound is a straight sharply defined red mark, suggesting that it was produced by the blow from the edge of one of the

heavy swinging plates. There is no bone protruding from the wound which is suspected of communicating with the fracture obviously about under it. This limb is 1 inch shorter than the left.

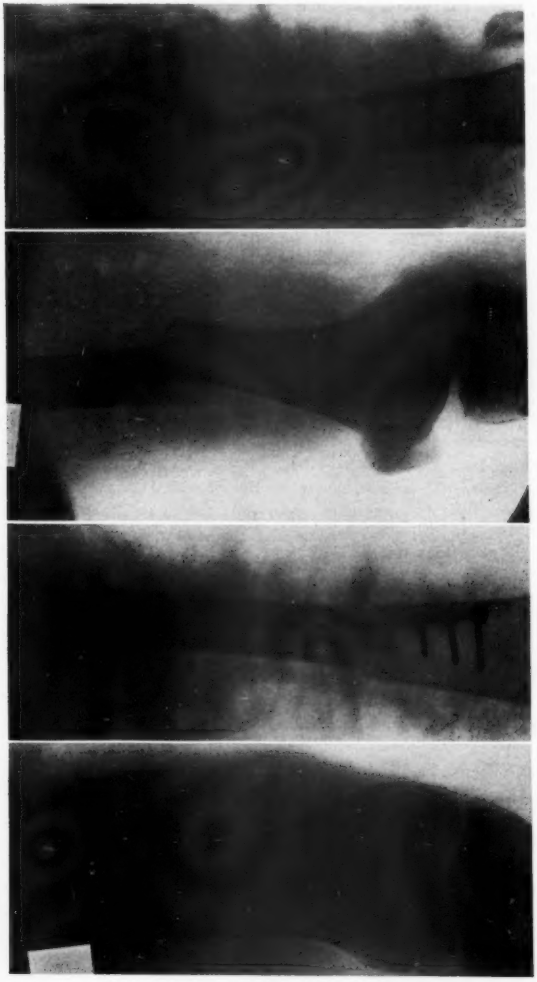


Fig. 400.—Case VII. Compound fracture of right femur. Open reduction and fixation by plate and screws.

Operation 4/3/29: After cleansing of the limb with green soap and water, drying, washing with ether, painting with tincture of iodin followed by alcohol

and draping with sterile sheets and towels, a small gauze pad, grasped in a long forceps and wet with iodin, was pushed through the small wound the size of which increased rapidly until it reached the fracture where it was very spacious. This was true of all compound fractures treated by the writer by this method, and is best explained by the separation of the fragments following the fracture, the anterior one making a gradually smaller wound as it approached and perforated the skin. The interior of the wound was swabbed as thoroughly as possible, first with iodin and then with alcohol. An 8-inch incision was then made over the fracture on the outer side, well posteriorly. Bleeding points controlled. Whole wound again swabbed with iodin and alcohol and the fragments approximated and fixed with a Lane plate and eight screws, which passed almost completely through both layers of compact bone (Fig. 400). Wound closed by a continuous catgut suture of the fascia lata and interrupted silkworm gut of the skin. No drainage. Plaster cast from chest to and including the foot.

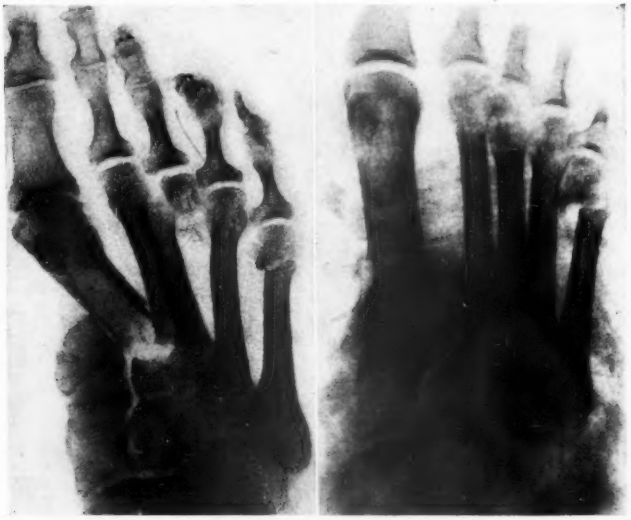
4/13: Condition since operation has been very satisfactory. Hole cut in cast to expose wound, which looked very good except that there was considerable tension of the skin and much thin red fluid was expressed through openings in the upper and lower parts of the wound. No evidence of infection. Wound washed with alcohol, painted with iodin, and covered with sterile gauze, moistened with alcohol, and bandage. Dressings changed every few days, the discharge decreasing. 4/24: Upper opening apparently closed, lower opening discharging small quantity of pus. 5/30: Dry scab covers wound and no discharge. Cast removed and wound evidently healing under scab. 6/6: Movement of fragments on each other at fracture line, *i. e.*, delayed or non-union. New cast applied including pelvis to ankle. 6/8: Out of bed on crutches. 6/15: Discharged. 8/19/29: Cast still on. Wound still healed.

This is the first experience the writer can recall in which plate and screws in a discharging wound were healed over, apparently permanently. In a compound fracture of the leg still under treatment, a screw, which could not be removed without chiseling around it, was left in and became healed over apparently without continued discharge from around it.

Case VIII.—Open Reduction of Metatarsal Fractures by Incision Through Abraded and Devitalized Skin.—This case is included here because of the special dangers of infection associated with operation, probably greater than from the ordinary wound compounding a fracture. On 10/27/22 a thirty-three-year-old stevedore had a heavy wooden beam fall on the dorsum of his right foot. He was brought immediately to the Northeastern Hospital where an *x*-ray showed a fracture of the bases of the first and second metatarsal bones with marked displacement of the fragments. There were also fractures near the heads of the third and fifth metatarsal bones with displacement. There followed marked swelling of the foot with numerous large blebs on account of which all consideration of reduction of the fracture deformities was postponed

for eight days after the accident. It was then concluded that by the closed method correction of the displacement was impossible and, without reduction, a much crippled foot must result.

Operation 11/4/22: The skin of the blebs was cut away on the dorsum of the foot and the plantar surface, disclosing on the dorsum a raw, red surface toward the inner side and superficial black areas on the outer side, indicating superficial devitalization of the tissues. The skin coverings of the blebs were first washed away with gauze pads wet with ether, the rubbing causing oozing of blood over most of the dorsum of the foot. The whole foot and lower leg were then painted with tincture of iodin and the iodin washed



A B

Fig. 401.—Case VIII. Simple fractures of first, second, third, and fifth metatarsal bones. Open reduction by incision through abraded and devitalized skin. A, Before and, B, after reduction.

off with alcohol, when the foot was draped with sterile sheets and towels. An incision about 3 inches long was made on the dorsum of the foot over the first metatarsal fracture through the abraded skin area and thick edematous tissue through which incision the fractures of the first and second metatarsals were exposed and the fragments approximated by the aid of a chisel. The wound was then swabbed with dichloramin-T and closed by chromic gut sutures without drainage. A sterile dressing and a plaster cast of the foot and leg were applied.

The *x*-ray taken the following day showed a good reduction (Fig. 401) 10/31. Because of moisture, a portion of the edge of the cast was removed.

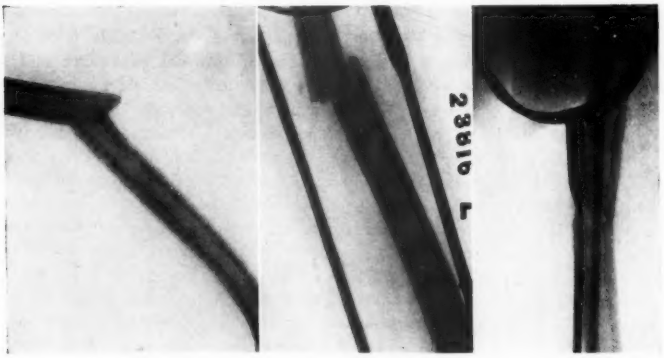
exposing more black necrosed skin surface, with some granulating areas about it. Ten days after operation the whole dorsum of the cast was removed revealing more black necrosing and granulating surface, but the operation wound showed no evidence of infection. Discharged 12/5, in the cast, to return for dressings. Cast removed finally six weeks after operation. 12/29: He is walking on crutches, with foot much larger than normal from thick, hard edematous tissue, and still showing considerable ulceration. He is advised to take weight on the foot.

Case IX.—Compound Posterior Dislocation of Right Ankle with Posterior Marginal Fracture of Tibia; Fracture of Internal Malleolus and of Middle Third of Fibula.—On 4/13/23 a twenty-three-year-old man fell from a horse, his foot becoming caught in the stirrup and the horse falling. He was brought immediately to the Northeastern Hospital. On examination it was evident he had a posterior dislocation of the right ankle-joint and there was a wound in the skin anteriorly just above the ankle. The surface of the wound and the surrounding skin were cleansed, the wound touched with iodin, and an alcohol sterile gauze dressing applied, the leg being placed in a fracture box. An *x*-ray showed a posterior dislocation and posterior marginal fracture of the tibia, and a fracture of the internal malleolus.

Reduction 4/14: Under ether the foot was cleansed and examined. It seemed evident that the anterior skin wound made the dislocation and ankle fractures compound. After sterilizing the field of operation and the interior of the wound with tincture of iodin and alcohol as in the preceding cases, and draping the field with sterile sheets and towels it was observed that the joint was very frail and that it was especially difficult to correct the displacement. The dislocation was reduced by pulling on the foot strongly downward and flexing it powerfully forward. After dressing and bandaging the wound, the reduction was maintained by fixing the foot in forced flexion. 4/11: *x*-Ray shows very much but not satisfactory reduction. In this fracture-dislocation, not compound, of which the writer had treated a fairly large number, he generally accomplished good reduction of the lateral deformity of which there is practically always some, but not quite satisfactory reduction of the posterior displacement. In all such preceding cases he was allowed a second trial which gave a satisfactory result. This patient absolutely refused a second trial, and against all advice insisted on being discharged, which was done on 4/13, the cast not being disturbed. He was followed afterward and had no infection.

Case X.—Compound Fracture of Both Forearm Bones.—On 10/22/23 a twenty-seven-year-old dyer had his hand caught in a machine and drawn backward around a revolving shaft breaking the radius and ulna about the middle. The fragments angulating forward produced a compound fracture of both bones anteriorly. He was admitted to the Northeastern Hospital late in the afternoon, the *x*-ray was taken about 8 P. M. and the operation was begun about 9 P. M. With the technic employed in the preceding cases the radial fracture was plated through a posterior incision. The wound was closed without drainage, the anterior compounding wounds not being sutured. Healing was uneventful and the patient discharged 10/29/23.

Case XI.—Compound Fracture of the Humeral Shaft Fixed by Traction.—A man, fifty-six years old, on 4/6/29 fell from a ladder injuring his left arm. He was taken immediately to the Northeastern Hospital. There was a freely bleeding oblique wound about 1 inch long on the anterior surface of the arm just above its middle. The upper fragment of a fractured humerus protruded through the wound. He was taken to the operating room about an hour after admission, the wound having received preliminary cleansing, painting with tincture of iodin, and covering with sterile gauze wet with alcohol and bandage. In the operating room the surrounding skin was washed with green soap and water, and painted with iodin and alcohol, and the field draped with sterile sheets and towels. The interior of the wound was then swabbed thoroughly with the iodin and alcohol, an alcohol sterile gauze dressing with more dry gauze and bandage applied, and the fracture fixed by a Jones traction splint with the arm at the side.



A B C

Fig. 402.—Case XI. Compound fracture of humerus. Reduction by traction. A, Before and B and C, two different views after reduction.

No infection occurred and on 4/17 the patient was discharged from the hospital. On 5/11 the splint was removed permanently the wound being healed and covered by a scab, and the fracture united.

Case XII.—Compound Posterior Dislocation of Elbow-joint.—On 11/3/23 a young factory hand had his left arm caught in a revolving belt by which it was carried around its pulley a compound posterior dislocation of the elbow resulting. He was brought immediately to the Northeastern Hospital. There was a lacerated wound anteriorly, extending from about 2 inches above the external condyle to about over the middle of the elbow-joint anteriorly the wound gaping widely and the whole of the articular process of the humerus projecting from it. The brachialis anticus muscle was torn across in the line of the skin wound, apparently in the whole width of the muscle. The patient

could move his fingers and hand indicating that the median nerve was probably intact, and as there was very little hemorrhage the important vessels were probably uninjured also.

Patient taken to operating room very soon after admission. Under ether the arm and forearm were first cleansed with tincture of green soap and water and dried. The field of operation was then disinfected with tincture of iodin followed by alcohol and draped with sterile sheets and towels. The interior of the whole wound including the elbow-joint was then swabbed out thoroughly with the same fluids. The original wound, 3 or 4 inches long, was enlarged upward and downward until it was 8 or 9 inches long. Sterile towels were clamped to the margins and the interior explored by retractors and fingers. The biceps muscle and its ulnar expansion, the bicipital fascia, were intact as well as the important vessels and nerves, all of which were on the inner side of the wound. The musculospiral nerve could not be seen, but was exposed by dissection and found intact.

The dislocation was reduced, but could be kept reduced only by acute flexion of the elbow. After reuniting the torn margins of the brachialis anticus by chromic catgut to maintain the reduction, two small longitudinal incisions were made into the joint posteriorly, one on each side of and close to the olecranon for dependent drainage. Both were closed loosely by a few silkworm gut sutures between which were left enough spaces to permit any joint and wound fluid to escape. After swabbing the anterior wound with dichloramin-T it was closed with chromic catgut sutures of the skin. Sterile alcohol gauze dressings and bandages were applied, and acute flexion of the elbow maintained by adhesive strips around the wrist and arm. 11/6: Free discharge of bloody serum. Dressings removed and wound exposed. No evidence of infection. Redressing. 11/13: Discharged from hospital with elbow still in acute flexion. No evidence of infection of wound, but small area of granulation tissue in it. 12/27: Has been slowly gaining motion. Flexion normal, extension about 130 degrees. Normal pronation and supination.

Case XIII.—Compound Comminuted Fracture of Humerus into Elbow-joint, Operation and Closure of Wound Without Drainage Five Days After Accident.—A healthy school girl, thirteen years old, on 8/20/22 was thrown from a horse near Fralyville, Md., injuring her left elbow which bled freely. Her mother cut off the sleeve of her dress to use as a tourniquet to stop the bleeding from a wound about 2 inches long postero-externally about 2 inches above the elbow-joint. She saw a piece of bone protruding an inch or two through this wound. Half an hour later, a physician dressed the wound and transported the patient in his automobile to a hospital in a neighboring town, where a surgeon under a general anesthetic reduced the protruding fragment, put a small gauze drain in the wound, dressed it and applied two right-angled wire bracketed splints.

On the following day she returned to her home near Philadelphia and came under the care of her physician, Dr. G. Victor Janvier. On the following day *x*-rays were taken which could not be seen until the next day. The next day she was admitted to the Howard Hospital in Philadelphia, about 3 P. M.

The writer saw her first about 8.30 P. M. The wire splints which the skiagrapher feared to remove made the first *x*-rays unsatisfactory. New ones

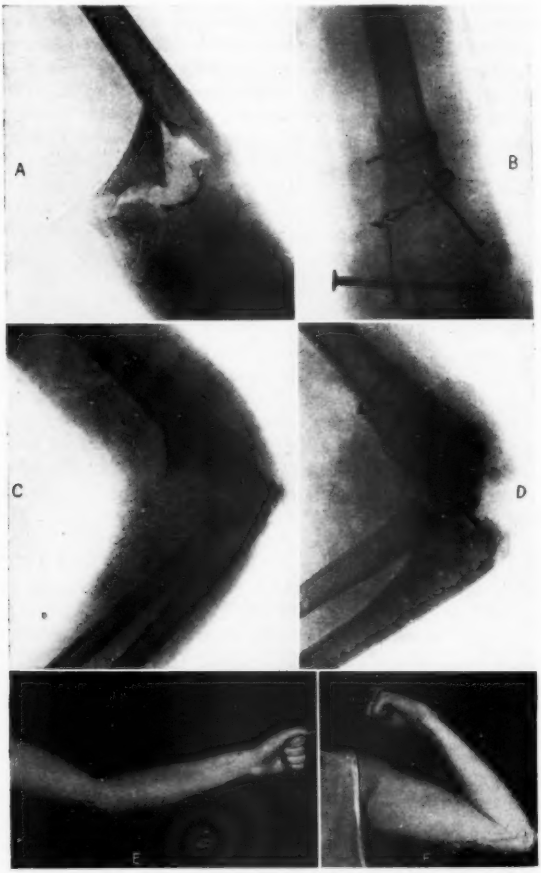


Fig. 403.—Case XIII. Compound comminuted fracture of lower end of left humerus. Open reduction and fixation by wire and nails. A and C, Before reduction. B and D, After reduction. E and F, Photographs of limb seven years after the accident. E, Shows forearm in extension and pronation, F, in flexion and supination.

were taken on the following day and were ready for inspection in the afternoon (Fig. 403, A and C). At least five physicians after examination had

emphasized the serious prognosis. It was now five days, on 8/25/22, when the operation was performed, the wound had been handled by at least three doctors, still had in the gauze drain which had been introduced on the first day and was discharging pus or something like it, but there were no other recognizable signs of infection locally or constitutionally. Previous unfortunate results in apparently less severe cases from a nonoperative method in one case and débridement with Carrell-Dakin technic in another decided the writer on a bolder course.

Operation (with the assistance of Dr. J. K. W. Wood): After a preliminary disinfection of the skin and interior of the wound, and a similar draping of the field by sterile sheets and towels, a horseshoe incision was made posteriorly, the convexity extending to just above the olecranon and the two lateral limbs running upward on each side of the triceps muscle which was cut through below and turned upward with the curved flap. This exposed the posterior surface of all of the fragments and the large wound thus made was again swabbed with tincture of iodin followed by alcohol and was protected from surrounding skin infection by clamping sterile towels to its margins. Special care was necessary to protect the ulnar nerve which was in danger from the much displaced internal fragments and the manipulations necessary to reshape all of the fragments together. This could hardly have been accomplished without the aid of the two pieces of wire and the three nails (Fig. 403, B and D). After swabbing the wound with freshly made dichloramin-T, the cut ends of the triceps were brought together by chromic catgut sutures and the skin margins by silkworm gut without drainage. Sterile alcohol gauze dressings and an anterior right-angled splint were applied. Fifteen hundred units of tetanus antitoxin were also given in this as was the antitoxin in all of the cases.

8/27: Redressing but no evidence of infection. 9/2: Redressing, much less serous discharge. 9/8: Discharge largely localized to site of original compounding wound above external condyle and to one opening above the internal condyle. Discharged from hospital.

9/22: All wires and nails removed at the Northeastern Hospital. Guarding the ulnar nerve required special care. 10/5: Discharged. 10/8: Splint removed. 11/18: Wounds healed. Some evidence of involvement of ulnar nerve. 12/9: Power of hand improving. Sensation imperfect in little finger and hypothenar eminence. 3/31: Flexion of elbow to about 45 degrees, extension to about 130 degrees. Full motion in little finger, but not quite normal power. Sensation in little finger almost normal.

CLINIC OF DR. CHARLES C. NORRIS

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FACTORS INFLUENCING GYNECOLOGIC MORTALITY AND MORBIDITY

WITH AN ANALYSIS OF THE RESULTS OBTAINED IN 4212 CASES OPERATED UPON IN THE JOHN GOODRICH CLARK GYNECOLOGICAL CLINIC

TRAVELING and seeing the work of other surgeons, attendance upon staff and medical meetings, recognition of the importance of follow-up, and other factors which afford a comparison of results have all tended toward an improvement and standardization of surgical methods and, while these methods always will differ in minor details, the general principles are becoming more or less uniform. Individual judgment and operative ability are two factors of vital importance for the welfare of the patient which can never be entirely standardized. The former has a particularly definite bearing upon the mortality rate.

Given sufficient practice almost any one can train himself to a certain degree of manual dexterity, but really good surgical judgment is much more difficult to develop. Spectators will always admire the former, and in certain desperate cases it may be the deciding factor between life and death. Speed is desirable, but endeavor to operate with great rapidity has probably killed more patients than it has saved. Dilatory methods, on the other hand, are inexcusable. With modern technic and skilfully administered anesthesia, however, the saving of a few minutes on the operating table is less important than the careful and conscientious performance of the operation. Furthermore, it certainly is of far less importance than the surgical judgment which, based upon the history and other circumstances surrounding the individual case, decides whether to

operate at all, and, if operation is decided upon, what operation to perform.

Gynecological patients who require surgical intervention may be divided into three groups, namely: (*a*) Good risks, (*b*) moderately good risks, and (*c*) bad risks. It is among the latter two groups, and especially in the really bad risks, that surgical judgment is of such vital importance. Periodic surgical audits, based upon mortality, morbidity, and follow-up results, constitute an integral part of every modern surgical clinic. It is only by a rigidly unbiased study of these results that we can hope to improve upon the general standard of our work. One of the difficulties with such audits is that they often are conducted by the head of the clinic and the one who probably performs the majority of the operations. Under even the most favorable circumstances, this tends to check free discussion of many cases. If it were possible to discuss fatal cases at staff meetings without the audience being cognizant of the identity of the surgeon responsible in each case, a more free and unhampered discussion of the merits of the employed treatment would be possible. In all events, at staff meeting, a rigid analysis of all cases brought for discussion is essential if the best results are to be secured.

By careful selection of cases, the young surgeon may be able to complete a long series of operations without mortality. The responsibilities of the operator are, however, fully realized only after the rigid self-analysis which follows an unexpected operative death. Even if every possible safeguarding measure has been taken, this self-analysis is very painful and, although a strict review of the case shows that nothing has been omitted or committed which calls for the slightest criticism, the conscientious surgeon is prone to question his judgment. Occasional operative deaths are certain to occur, but severe self-analysis and critical study of all these cases by each member of the staff are not only proper but are beneficial to the general character of subsequent work, ensuring further safeguard for future patients. That some particular operative death was unavoidable and nobody's fault may be true, but this is an

undesirable viewpoint to assume and, as a matter of fact, generally an incorrect one.

MORTALITY

Total number of patients operated upon 4212
Number of postoperative deaths, any cause ..... 24 (0.57 per cent.)

CAUSES OF DEATH, WITH PERCENTAGE BASED ON NUMBER OF DEATHS

Infection	Peritonitis	5	9 or 37.5	per cent.
	Septicemia	3		
	Pelvic abscess	1		
Embolism		3	12.5	"
Cardiac disease		3	12.5	"
Cerebral hemorrhage		2	8.33	"
Uremia		3	12.5	"
Slipped ligature		1	4.16	"
Transfusion reaction three weeks after operation		1	4.16	"
Acute pulmonary collapse		1	4.16	"
Pneumonia		1	4.16	"
	Total	24		

OPERATIVE RISKS

Causes of death, 24 cases.		Good operative risks.	Moderately good operative risks.	Bad operative risks.
Infection	Peritonitis	2	1	2
	Septicemia	1	1	1
	Pelvic abscess			1
Embolism		1	2	
Cardiac disease			3	
Cerebral hemorrhage			2	
Uremia			1	2
Slipped ligature				1
Transfusion reaction three weeks after operation				1
Acute pulmonary collapse			1	
Pneumonia				1
Total		4	11	9

The foregoing is an analysis of the mortality and morbidity observed in the John Goodrich Clark Gynecological Clinic at the Hospital of the University of Pennsylvania during the last seven years.

What constitutes the good and bad risks is easy to define. Among the moderate risks have been placed all patients suffering from complications, such as renal, pulmonary, hepatic, or cardiac disease, but in good general condition; also patients suffering from moderate grades of anemia, those in whom the operative difficulties were extreme, and all others who although in fairly good general health showed some defect detrimental to the safety of the operation. It goes without saying that the worse the operative risk, the more definite should the indications for operation be. A woman with a moderate degree of laceration of the pelvic floor should, properly, be advised to submit to a perineorraphy if she is a good operative risk, as the comfort gained would be well worth the almost negligible risk incurred by the operation. If, on the other hand, the woman suffered from a pulmonary tuberculosis or from a cardiac lesion with decompensation, such advice would obviously be unwarranted.

Certain lesions, *e. g.*, carcinoma, may be almost symptomless in the early stage, but must be treated with promptness if a cure is to be secured. These, together with such acute conditions as torsion of the pedicle of an ovarian neoplasm, ruptured ectopic pregnancy, and diseases complicated by severe anemia or associated diseases of grave nature, constitute the bulk of the bad operative risks.

Many gynecologic lesions are not in themselves fatal and the operative risk and likelihood of permanent relief of symptoms should be carefully considered before deciding whether to operate or not. One of the advantages of accurate follow-up studies is that they enable a surgeon to determine with almost mathematical exactness the chance of relief that he can offer the individual patient.

Many gynecologic lesions may be treated palliatively with complete success. In others, comfort to the patient may be

secured, although a cure may not be effected. With some enthusiastic surgeons the use of the pessary is a lost art. With the improvement in operative technic and the lowering of operative mortality, the field of operative treatment has widened. No operation, however, is so trivial that every step to safeguard the patient should not be employed, nor is any operation entirely free from the danger of a fatal termination. Major risks have to be taken, but every effort should be made to minimize them by preoperative study and care, and operative judgment and technic should be exercised to the utmost.

About 75 per cent. of our operative cases are classed as good risks, 20 per cent. as moderate risks, and the remaining 5 per cent. as bad risks. Thus, of the 4212 cases under analysis, 3160 were good risks. Among them 4 deaths occurred, giving a mortality rate of 0.1 per cent. Eight hundred and forty-two cases were moderate risks, with 11 deaths or a mortality rate of 1.3 per cent. Among the 210 bad risks there were 9 deaths, or a mortality rate of 4.2 per cent.

An analysis of our chart on mortality (p. 1097) shows that in 9 cases (37.5 per cent. of all deaths) the fatality was due to infection. Six of the 9 patients in question were of the septic class prior to operation, but the remaining 3 were so-called clean cases and the deaths were probably caused by some faulty operative technic. In one of these last cases an extensive plastic operation was performed, and the source of infection was probably the operator's throat. This happened prior to the adoption of our present technic, which requires all persons on the operating-room floor to wear masks, even for plastic operations.

The 3 deaths from emboli all followed major operations and in each case careful preoperative studies had been made. The 3 cardiac deaths all occurred following imperative operation upon patients who had been given careful preliminary treatment. One of these patients suffered from a grave aortic lesion, but in the remaining two the heart was normal. Two of these patients suffered from carcinoma, and the third from a large myoma. Uremia accounted for 3 deaths occurring in

patients requiring major operations for carcinoma. In one of these cases the urine contained albumin and casts prior to operation, while in the other two, the urine and blood-pressure were normal. The small incidence (2 cases) of death due to pulmonary complications is an indication of careful preoperative care and well-administered anesthesia.

The following is a summary of the postoperative complications which have been encountered in the present series of cases:

Operations.		Deaths.
Vaginal	2439	8 (0.32 per cent. or 1 in every 304 patients)
Abdominal	1345	12 (0.89 per cent. or 1 in every 112 patients)
Combined vaginal and abdominal	428	4 (0.93 per cent. or 1 in every 107 patients)
Total	4212	24

In our clinic combined vaginal and abdominal operations are routinely performed when required, provided the patient's condition permits. No hard and fast rule is adopted, the decision resting entirely upon the surgeon's judgment. My personal opinion in this respect is that it is best to err on the side of safety. As a matter of fact, with careful preoperative care and properly administered anesthetics, combined operation can generally be performed with safety. Safety is the vital factor but, on the other hand, many patients require both vaginal and abdominal operation to effect a cure. A two-stage operation has many drawbacks and carries a double risk as far as certain operative hazards are concerned. Two-stage operations are, however, often necessary in cases of pelvic abscess, the primary operation being a vaginal incision and evacuation of pus. In some of these instances, a complete operation from above may be necessary at a later date to secure relief from symptoms. The operations for laceration of the vagina and for retroposition can almost routinely be combined. In this class of cases the patient is usually in good condition, and neither the abdominal nor the plastic operation is successful alone. Two-stage operations are extremely trying to the patient, and it is

therefore far preferable, from every point of view, to complete the work at one sitting when this is compatible with safety. As may be seen from the table on page 1100 our combined operations have given practically the same mortality rate as that of uncomplicated laparotomies.

In a recent study, Polak and Tallefson[1] have shown that, in their hands, the routine removal of the appendix is inadvisable. Although routine appendectomy theoretically should result in a greater number of operative complications, we have not found this to be the case in practice in our clinic. Moreover, it is difficult and impossible to estimate the benefits derived from this operation. In the series forming the basis of this study, routine appendectomy was practised when the patient's general condition was good at the completion of the intra-abdominal work, and when the operation presented no particular difficulties.

Wound Infection.—Among 1773 abdominal or combined vaginal and abdominal operations the following infections occurred:

Grade A	106
Grade B	26
Grade C	1
Total	133 (7.5 per cent.)

The severe grades of infection often come from within and, less frequently, from breaks in operative technic. Absolute hemostasis, the avoidance of unnecessary trauma, and the use of thin ligatures combined with the proper wound protection, will prevent nearly all the minor grades of wound infection.

Pelvic peritonitis or *parametritis* developed among 1773 laparotomies: 19 times following operations for pelvic inflammatory disease; 10 times following operations for myoma of the uterus; once following operation for retrodisplacement of the uterus.

Operation during the acute stage of a pelvic peritonitis, or in too short a time after an acute exacerbation, is frequently the cause of these postoperative complications.

The following complications developed in the entire series (4212 cases):

[1] Polak, J. O., and Tallefson, D. G.: Am. Jour. Obst. & Gyn., October, 1928.

Phlebitis		28 cases or 0.66 per cent.
Bronchitis, postoperative		16 cases or 0.38 "
Pleurisy following operation for:		
Myoma	5	16 cases or 0.38 per cent.
Extra-uterine pregnancy	2	
Ovarian neoplasms	4	
Incomplete abortion	1	
Plastic operations	1	
Pelvic inflammatory disease	2	
Retroversion of the uterus	1	
Pneumonia following operation for:		
Pelvic inflammatory disease	2	11 cases or 0.26 per cent.
Myoma	6	
Endometrioma	1	
Extra-uterine pregnancy	1	
Rectocele	1	
Acute pulmonary collapse		3 cases or 0.07 per cent.
Intestinal obstruction, postoperative		2 cases or 0.04 "
Acute gastric dilatation, postoperative		3 cases or 0.07 "
Hemorrhage, postoperative, from:		
Plastic operation upon the cervix	10	15 cases or 0.35 per cent.
Plastic operation upon the perineum	4	
Slipped ligature from ovarian vessel	1	

A careful preliminary study and properly administered anesthesia, with ordinary efficient postoperative care, should almost eliminate most of the postoperative pulmonary complications.

Cystitis, postoperative	27 cases or 0.66 per cent.
Pyelitis	21 cases or 0.49 "
Deaths	24 cases or 0.57 "

Primary hemorrhage is an inexcusable postoperative complication and is generally the result of carelessness or haste, or both. Double ligatures with triple tied knots upon all main vessels will prevent the more serious forms of this accident. In our clinic, oozing following plastic operations upon the cervix has been about two and a half times as frequent as from operations upon the vagina. Secondary hemorrhage due to premature absorption of catgut or defective ligatures occasionally occurs, but is a rare complication in these days of excellent commercially prepared catgut. The occasional inadvertent use of catgut of

smaller caliber than called for accounts for a proportion of secondary hemorrhages. The suture nurse may readily make such a mistake, which may be unlooked for by the operator.

Figures such as the above show little, except the general trend of surgical results. Thus Polak and Tallefson[1] record an operative mortality of 2.9 per cent. (3125 operations with 95 deaths), and Peterson[2] 16 deaths among 1734 operative cases, a mortality of 0.58 per cent., as compared with our own mortality rate of 0.57 per cent. Later or earlier studies from these clinics might readily transpose the figures. They do, however, demonstrate that in carefully conducted clinics the mortality rate is small, and an analysis of our own cases demonstrates that it should be still further reduced.

As previously stated, 37.5 per cent. of our deaths were due to infection. Operating too early after an acute attack of pelvic inflammatory disease undoubtedly accounted for some of these fatalities.

An analytical review, such as is here attempted, must necessarily be incomplete. It is probably always of more interest and benefit to the surgeon who makes the review than to the reader. The essayist can do little more than suggest points which in his experience are of importance and tend to improve results. Most of these are well recognized and do not require to be stressed. Details of technic which require adjustment in the writer's service may be well-nigh perfect in many other clinics. It is not, however, transgressing to state that some hospitals require a careful check-up on their surgical results. This can be attained in part at least by an unbiased periodic audit of the mortality rate in the various services.

Certainly of equal if not of greater value is a check-up upon end-results. Without this we are working in the dark, as far as the relative merits of different forms of treatment for the various malignant neoplasms are concerned. It also offers a partial check-up on the reliability of the work of the pathologist.

[1] Polak, J. O., and Tallefson, D. G.: Am. Jour. Obst. & Gyn., XVI, No. 4, p. 600, 1929.

[2] Peterson, R.: Jour. Am. Med. Assoc., 92, 23, 1907, 1929, June 8.

The histologic diagnosis of gynecologic specimens is by no means satisfactorily performed in many hospitals. Of very great importance is the follow-up in its relation to relief of symptoms. No business could be conducted today without a periodic audit, and this is what the follow-up constitutes for surgical work. The majority of gynecologic operations are not lifesaving but are performed in order to give the patient relief from painful symptoms. The choice of the operation depends upon the surgeon, and how can he be expected to make a correct estimate of the value of his work unless he is aware of the end-results? This follow-up is expensive in that it requires special clerks and adequately trained follow-up field workers. It is, however, essential for the best interest of the hospital, the patient, and the surgeon. The writing of "cured" upon the discharge card by no means ends the responsibility of the surgeon or the hospital. This is expecially true in regard to gynecologic patients. That a satisfactory anatomic result is recorded, often by an assistant or intern, is no proof that the patient has been relieved from the symptoms which were present prior to the operation.

Preoperative Study.—No case is too trivial to require a thorough preoperative study. When operation has been decided upon, the patients generally wish to have the ordeal over with as short a preoperative stay in the hospital as possible. It is impossible to safeguard the patient who comes to the hospital on the day preceding the operation. Forty-eight hours' preoperative stay in the hospital is imperative, and in many cases a longer period is necessary. This does not apply to emergency work which, however, fortunately is relatively infrequent in gynecologic practice.

Anesthesia.—Proficiency of the anesthetist is of greater importance than is the choice or method of anesthesia. Neither safe nor satisfactory anesthesia can be expected when its administration is entrusted to an intern whose term of service is limited, and whose interest often centers on the operation instead of on the anesthesia. It may be necessary in some hospitals to allow an intern to act as anesthetist in major operations, so that

he may gain experience. In no case is such a practice justifiable without the constant supervision of an experienced anesthetist and is not, as a rule, to the best interest of the patient or surgeon, even with such supervision.

There are many contraindications relative to general anesthesia. The presence of a slight cough or "cold" is one of the most important. The strict attention paid to such complications in all elective work accounts, I believe, for the relative absence of pulmonary complications in the present series. Of all anesthetics, ether is especially prone to produce an exacerbation in these cases and, even if no actually alarming postoperative symptoms develop, extreme discomfort to the patient is prone to result.

Operative Technic.—Wound protection, preferably by rubber dam, as practised by N. S. Heaney of Chicago, combined with careful hemostasis and gentleness in the handling of tissues, is important to the careful surgeon. Complete peritonization is of vital importance for the prevention of adhesions and for the subsequent comfort of the patient. As suggested by the late John G. Clark, the routine administration per rectum of 1000 c.c. of water at the completion of a plastic or, especially, an abdominal operation, is a valuable procedure. To the enema may well be added glucose, as suggested by George Gray Ward of New York. Such an enema rearranges coils of intestines which may have been displaced during operation, supplies liquid, and applies heat over the viscera. Prior to the administration of the anesthetic a rectal tube is inserted and held in place by adhesive plaster. The enema is given while the abdominal wound is being closed, or immediately following the completion of the operation. While it is being given the patient should be in the Trendelenburg position. Patients so treated suffer less than others from postoperative thirst and eliminate more urine during the first twenty-four hours after operation.

CONCLUSIONS

1. Preoperative study and care are of the utmost importance, but are impossible when a patient is operated upon within

twenty-four hours of admission to the hospital. For obvious reasons, bad surgical risks are less likely to be neglected in this respect that are patients who are apparently in good physical condition.

2. Transfusion should be employed routinely in anemic patients in both the pre- and post-operative stage.

3. Slight coughs and "colds" are absolute contraindications to elective operations which are to be performed under a general anesthetic.

4. A competent anesthetist is an essential. Anesthesia by interns is usually unsafe and unsatisfactory.

5. Operative technic:

(*a*) Wound protection and absolute hemostasis are essential for the successful healing of abdominal wounds.

(*b*) All persons on the operating-room floor should be masked. The masks should cover both nose and mouth.

(*c*) A rigid check on aseptic technic should be constantly in force. New assistants and nurses should be especially instructed in this respect, and carefully checked-up upon.

6. Despite the many valuable contributions to the subject, patients with pelvic inflammatory disease are still being operated upon too often and too early in many clinics.

7. An efficient follow-up department is of vital importance to every gynecologic clinic. Discharge from the hospital by no means ends the responsibility of either surgeon or institution. Without a follow-up it is impossible to judge results, and it is only by a study of results that future patients can be benefited by past experience. Many hospitals and busy surgeons do not realize the importance of this point.

CLINIC OF DRS. JOHN BERTON CARNETT AND EUGENE A. CASE

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A CLINICAL AND PATHOLOGICAL DISCUSSION OF SO-CALLED SUBACROMIAL BURSITIS

I HAVE invited several patients to meet you today who exhibit various phases of the affection commonly called "subacromial bursitis." In a paper written in 1924 and published in Surgery, Gynecology and Obstetrics in October, 1925, I gave the data on 44 cases of so-called "subacromial bursitis" with calcareous deposits, in 19 of which I had the opportunity to examine the lesions at open operation. Since then my experience has more than doubled both with operative and non-operative cases. I have also studied numerous cases of the symtom-complex known as bursitis, but in which no calcareous deposit could be demonstrated by skiagrams.

Whether calcareous deposits are present or not the clinical picture of these cases is quite similar, although the non-calcareous cases are usually milder; hence, the underlying lesion is presumably the same. Frank suppuration sometimes occurs within the subacromial bursa, but we are not considering that type of lesion today. I am convinced that toxemia is not a factor of any moment in producing the lesion in the cases I have seen. I am not in sympathy with the generally accepted view that bursitis is practically always due to an external or internal single acute trauma with injury to the bursa resulting either directly, as by a blow or violent pinching between the acromion process and greater humeral tuberosity, or indirectly, by rupture of some of the fibers of the underlying supraspinatus tendon. In the great majority of my own cases and of the cases reported by several writers, there was entire absence of any trauma ade-

quate to cause damage to the bursa or tendon. A single trauma may be an exceptional, but is not the usual etiologic factor. In many cases I believe the trauma excites inflammation around a pre-existing symptomless calcareous deposit.

I have operated upon the bursa in only 2 cases in which a calcareous deposit was not present and both of them resulted from a single trauma, but they were both atypical of the general group we are discussing.

One of these cases was a miner, forty years of age, who eight years previously attempted to break his fall in slipping down a mountain side by throwing his right hand backward against the ground. He felt something give way in his right shoulder and the shoulder has been persistently weak ever since. For several weeks his right arm hung limply at his side. It was several months before he could put on his coat by natural motions. He has had pain and soreness about the right shoulder and upper arm ever since. On admission the right arm could be abducted directly from his side, but it was weak and at any level could easily be forced down by gentle pressure. Circumduction of the arm in the horizontal plane at the shoulder level caused distress. Has had pain, somewhat suggestive of bursitis in the left shoulder since it was "twisted" over two years before hospital admission. Left shoulder worse recently, hence his seeking relief when he came to the hospital five years ago. Skiagrams of both shoulders did not reveal any abnormalities.

I operated on the right shoulder. Immediately on separating the deltoid, the head of the humerus was exposed to view. The supraspinatus had been torn away near its insertion to the humerus. Its proximal end had retracted and could not be found. The long tendon of the biceps was dislocated from its groove. The subacromial bursa could not be identified. I removed the protruding supraspinatus stump from the humerus on the assumption that it acted as an irritant in movements of the shoulder-joint. I saw the patient one year later when he was free from pain in both shoulders, but weakness in the right arm still persisted.

Codman states that in complete rupture of the supraspinatus the patient is unable to start abduction when the arm hangs at the side. Once started, however, the deltoid can carry it up. His cases were comparatively recent ones, whereas my case was of years' standing. This one case is the only one of complete or partial traumatic rupture of the supraspinatus that I have been able to recognize, although I have been on the lookout for the lesion since Codman first described it some fifteen or twenty years ago.

The second bursa case without deposit on whom I operated was a colored woman who slipped in going down stairs and to save herself from falling, threw her right hand upward, outward, and backward with the palm against the wall. Three hours later she began having severe pain at the point of the right shoulder, but did not consult a physician for three days. A faulty skiagram then led to a mistaken diagnosis of dislocation of the shoulder and she was referred to me for reduction. It was obvious she did not have a dislocation and this opinion was confirmed by another skiagram. The patient had exquisite pain limited to the upper deltoid region. The outer aspect of the right shoulder bulged prominently and was widely tender. Fluctuation was easily demonstrable beneath the deltoid. She absolutely refused to attempt any active shoulder motions and resisted efforts to test for passive motion. I suspected she had a rupture of the supraspinatus tendon.

I operated on the fifth day after her accident. On separating the deltoid fibers, the tense bursa heaved itself forward into the wound and resembled a wax injected specimen. On incising the bursa a large quantity of slightly blood-tinged serous fluid escaped. Bursal walls were intact and uniformly congested in so far as they could be inspected. Careful search including splitting of the bursal floor failed to disclose any tear in the supraspinatus tendon. Incisions in bursa were left open, a rubber tube drain was inserted, and the deltoid and skin were sutured. She had immediate relief from pain, and when she left the hospital on the seventh day, limitation of motion was mainly in the direction of abduction. She soon regained full range of motion. Recovery would probably have been as prompt with single or repeated aspirations. I have not encountered any similar case. There must have been 3 or 4 ounces of fluid in her bursa, but I have not seen over one dram in any other operative case, although other writers report its frequent occurrence in calcifying bursitis.

In approximately 50 cases of calcareous deposits in which I have seen the subacromial bursa exposed at operation I was not able to detect any pathologic changes in the bursa itself in the majority of instances. The one constant lesion in these cases was the calcareous deposit situated beneath the bursa on, in or under the supraspinatus tendon. There was no material difference in the clinical symptoms as between the cases in which the bursa was normal and those in which it showed slight redness in the region of the deposit of few or many adhesions.

I have removed sections of the bursa and of the tendon in many of these cases for microscopic study and Dr. Case, who is present, will later describe to you the constant lesions he finds in the tendon and the infrequency of any abnormality in the bursa. I, therefore, believe that the symptoms commonly ascribed to bursitis are in reality due to a lesion of the supra-

spinatus tendon irrespective of whether a calcareous deposit is present or not. I have never seen at operation any evidence of recently torn tendon fibers or blood-clots as described by some writers and Dr. Case will tell you he had found slight traces of blood-pigment in only 1 or 2 cases.

ETIOLOGY

The common cause of this tendon lesion seems to be occupational traumata. It is seen most frequently in such individuals as typists, machine operators, pianists, chauffeurs, etc., who work with their hands while their elbows are held away from the sides of the chest. In this position the supraspinatus tendon is subjected to bruising or pinching trauma between the greater tuberosity and the acromium or the coraco-acromial ligament.

Judging by the specimens removed at operation these repeated occupational traumata excite an inflammation in the tendon with consequent disturbance of blood-supply and necrosis of tendon tissue which may be followed by the deposition of calcium and other mineral salts. Clinical symptoms presumably may occur at any stage of this pathologic process. On the other hand there is ample evidence to prove that the entire process may progress to the extent of forming large deposits without giving rise to any clinical symptoms. I have seen 6 cases of bilateral calcareous deposits without symptoms discovered accidentally in skiagrams. Curiously, all 6 cases were noted in chest skiagrams of patients having cancer of the breast. Within the past few days I was told of another accidentally discovered case of bilateral deposits in the skiagram of the chest of a patient having a cardiac lesion.

SYMPTOMS

Subacromial bursitis, particularly in its calcareous form, is very rare before the thirtieth year of age. The symptoms of bursitis vary greatly in different patients in accordance with the severity and stage of the lesion which may be acute, subacute, or chronic. The onset may be insidious, but is often abrupt and viciously painful. Usually no history of shoulder trauma is obtainable. In a minor percentage of cases patients give a

history of an automobile or other accident or unexpected strain involving the shoulder muscles.

Cases of acute onset usually present symptoms of pain in the distribution of the brachial plexus and marked limitation of shoulder movements. The pain may extend all the way from the neck to the finger-tips or may be restricted to an area in the arm or in the arm and forearm. Frequently the pain is most severe in the lower half of the deltoid region. Almost never do patients make any special complaint of the region immediately overlying the bursa. In the hyperacute cases the pain is agonizing and requires large doses of morphin for its control. Physicians not familiar with bursitis nearly always diagnose these cases as brachial neuritis and treat them in vain by tonsillectomies, tooth extractions, and other measures directed against possible toxic foci. The condition is not a true neuritis as reactions of degeneration do not occur. The preceding symptoms are those of brachial neuralgia and by far the most common cause of brachial neuralgia is subacromial bursitis. In brachial neuralgia from other causes it is very rare to find limitation of passive shoulder motion. In acute bursitis both active and passive motions are greatly limited because of pain and muscle spasm. Restriction is most marked in abduction and inward rotation and is less in external rotation. Backward and forward swinging of the arm with the elbow flexed and close to the chest is the least restricted motion and is painlessly possible to a greater degree than in acute arthritis of the shoulder.

In bursitis, both acute and chronic, there will be found a sharply localized tender area never exceeding a quarter dollar in size situated immediately beneath the edge of the acromion process and anywhere along a line extending from the bicipital groove outward nearly to the external aspect of the humerus. Tenderness is most frequent in the region of the greater tuberosity. Skiagrams reveal the tender area coincides with the location of the calcareous deposit when the latter is present and presumably corresponds with the tendon lesion in the absence of deposit. Many individuals with otherwise apparently normal shoulders have tenderness, usually much less marked than in bursitis,

over the greater tuberosity. Atrophy of the supraspinatus, infraspinatus, and deltoid muscles occurs early.

The majority of acute and hyperacute cases lose their severe pain in from three to five weeks and many then proceed to rapid and complete recovery, but many of them pass over into a subacute or chronic form and have milder symptoms going on for months or years.

Subacute and chronic cases may begin as such without a primary acute attack. They may have symptoms quite similar to the acute but much milder in degree. Some of them, however, may experience pain only in certain motions of the shoulder, particularly abduction.

Raising the arm outward and upward from the side is painless at the start, but more or less severe pain is encountered while the arm is passing through that portion of the arc from 75 to 90 degrees and is again painless in passing from the 90- to 180-degree angle. Similar pain is experienced through the same arc in bringing the arm down again to the side of the chest. At the 75- to 90-degree angle the sensitive lesion, whether in bursa or tendon, is compressed between the tuberosity of the humerus and the acromion process. Above the 90-degree angle the lesion has passed under the clavicle and is free from pressure. Chronic cases are prone to have mild exacerbations and may at any time develop a very acute flareup. Many of the chronic cases have some restriction of shoulder movements due to habit contractures from prolonged disuse of the full range of motion during periods of severer pain.

Many writers who have not operated on the subacromial bursa ascribe adhesions within the bursa as the main cause of stiff shoulder-joints and describe crackling sounds incident to the bursal adhesions being broken up when the shoulder is manipulated under an anesthetic.

I have encountered adhesions of any moment in only one operative case of bursitis. That patient is here for your observation. He and a fellow physician are anxious to get away and I will demonstrate their conditions now. The first physician is the skiagrapher designated as Case III and skiagrams of his

shoulder are shown in Fig. 10 of my previous paper.[1] He had several weeks of mild chronic symptoms in his left shoulder and then had an intermission with complete absence of all symptoms for a few days. In taking a bath one evening he was delighted to find he could use the see-saw motion of the towel to dry his back without any pain or limitation of shoulder movement. Five hours later he was roused from sleep by vicious pain and all the symptoms of an acute attack of left subacromial bursitis. I operated the same day, January 16, 1923, removed a calcareous deposit, and broke up extensive fibrinous adhesions of at least three weeks' duration which had obliterated the bursa. Notwithstanding these extensive adhesions he had full free range of shoulder motion within sixteen hours before operation.

The most restricted motion in the shoulder that I have seen in any case of chronic bursitis is this second physician who is described as Case IV in my former paper. He had several months of chronic pain followed by an acute exacerbation and operation on December 31, 1920. His bursa was entirely free from any evidence of adhesions or of other pathology. A calcareous deposit was removed from his supraspinatus tendon. Before closing the incision I used great force in manipulating his arm with resulting "snapping of adhesions." Had these manipulations been performed without opening the bursa many surgeons would unhesitatingly have described the case as one of intrabursal adhesions.

Other cases similar to the extensive adhesions in the bursa without restriction of the shoulder in the skiagrapher and the marked shoulder restriction without intrabursal adhesions in the general practitioner have made me very skeptical as to bursal adhesions being a common cause for "stiffness" of the shoulder. Brickner has described cases of bursal obliteration by adhesions without loss of abduction. In bursitis I believe the limitation of motion is due in the acute cases to muscle spasm and pain, and in the chronic cases to contracture of all the soft tissues—with possibly some adhesions between them, around the joint with prolonged maintenance of one position.

[1] Surgery, Gynecology, and Obstetrics, October, 1925.

DIAGNOSIS

The diagnosis of this affection, as a rule, is not difficult on history and physical examination. The distribution of pain, the characteristic limitation of shoulder motion, and the sharply localized area of tenderness are fairly distinctive. Some bursitis cases resemble arthritis of the shoulder, but in the latter tenderness is found around the entire circumference of the humeral head instead of being sharply localized at one spot anteriorly.

Skiagrams are very helpful not only in excluding other possible shoulder lesions, but also by demonstrating a calcareous deposit when it is present.

Calcareous deposits are tricky lesions and the diagnostician must be aware of their peculiarities, concerning which very little is contained in literature, in order to avoid various possible errors. The shadows cast by the deposits are frequently obscured or totally lost in the overlying bone shadow in skiagrams as ordinarily taken of the shoulder-joint. In the usual skiagrams there is an overlapping of the shadows of the humeral head and the acromion process at the area in which deposits are most commonly found. It is most important that these two shadows be separated from one another so that the deposit shadow stands out clearly between them. With the patient lying on his back with the film under his shoulder by directing the rays from above downward and from within outward rather than the usual direct from front backward, a clear space will be shown between the head of the humerus and the acromion process.

Stereoscopic films made under these conditions are the most reliable means of locating deposits and differentiating them from osteophytes, from fracture of the tuberosity, and from the occasional local bone condensation and other bone lesions found in the head of the humerus.

If stereoscopic films are not taken then it is imperative that skiagrams be taken both in extreme inward and in extreme outward rotation of the humerus. For the inward rotation view the hand of the flexed elbow rests on the patient's abdomen, and for the external rotation view the elbow is flexed to a right angle and the hand turned away from the body till the back of

the hand rests on the table. The same positions of extreme inward and outward rotation of the humerus can be obtained with the elbow extended by forcible pronation and supination of the hand. In one view or the other the deposit shadow will be shown clear of the humerus shadow whereas, in the opposite view the deposit shadow is frequently obscured or completely hidden by the humerus shadow.

A negative diagnosis of calcareous deposit should never be given unless all the preceding precautions have been carefully observed.

By determining the location of the area of localized tenderness it is possible to predict which view will show the deposit shadow. When the tenderness is at or near the greater tuberosity the deposit will be shown in the external rotation film and when the tenderness is near the outer margin of the shoulder the shadow will be shown best in internal rotation.

I have seen only one patient in whom excellent films were negative for deposits and who subsequently developed them. The skiagrams in her case were negative after one year of bilateral bursitis symptoms, but were positive for both shoulders about eight months later. It is probable that similar cases might have been discovered had I resorted more frequently to follow-up skiagrams in cases that were negative at the first examination. I have seen only 4 cases in which known deposits enlarged while under observation. One of them is shown by this skiagram of the right shoulder of the skiagrapher who had the extensive adhesions of his left bursa. The small deposits in his right shoulder were first discovered in January, 1924, after the onset of mild symptoms. He has never had any severe pain in this shoulder; otherwise he states he would have had it operated. He has recurrent mild attacks with entire freedom between attacks and has least trouble during the summer months. During the first eight months after their first discovery there was a gradual absorption of his small deposits. He took numerous diathermy treatments. Much to the surprise of both of us a recent picture taken before he came here today shows a large shadow as depicted in this film (Fig. 404). I have seen one

other patient in whom the deposit definitely enlarged during a period of several weeks while the patient was undergoing active diathermy treatment.

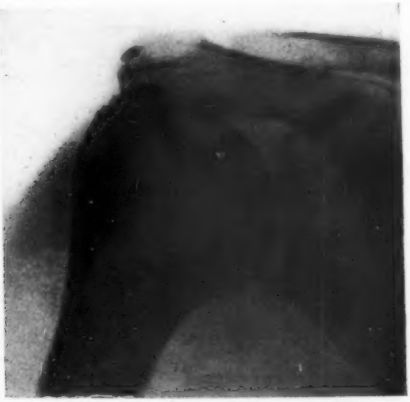

Fig. 404.—A deposit that has increased in size while under observation.

Fig. 405.—Deposit in right shoulder shown best in external rotation. Deposit extends unusually high under acromion process. Active clinical symptoms.

About one out of every three patients who complain of symptoms in one shoulder only are shown by skiagrams to have deposits in both shoulders. This patient has been having acute symptoms in his right shoulder for two weeks and has never had any trouble in his left shoulder. This film of his right shoulder (Fig. 405) shows a large deposit extending high up under the acromion suggesting that it may have ruptured into and diffused through the bursa, but in another patient with an entirely similar skiagram I had great difficulty in removing the deposit from the tendon high up under the acromion. This film of

Fig. 406.—Deposit in left shoulder. Shown best in internal rotation. Unusually large deposit for a symptomless shoulder. Same patient as Fig. 405.

his left shoulder (Fig. 406) shows an unusually large deposit for a symptomless shoulder. The quiescent deposit may remain dormant for years or may give rise to symptoms at any time. An attack first in one shoulder and then in the opposite shoulder a year or more later is not unusual. Symptoms in both shoulders simultaneously are not very rare. I have mentioned one such case and we have another one here today. He is a newspaper editor who was hospitalized about four years ago with symptoms diagnosed as bilateral brachial neuritis. He

had tonsils and teeth removed without improvement. When he later came under my observation I sent him to the skiagrapher, who was present today as a patient, for examination of both shoulders. He reported both shoulders negative for deposits. This skiagrapher is particularly skilful in disclosing deposits, but in this instance he failed to adjust the rays to separate the acromial and humeral shadows. I sent the patient back for further examination by correct technic and then large deposits were shown in both shoulders as evidenced by these diagrams. He has not had any bursitis symptoms for the past three years. He was rerayed three days ago and these recent pictures show deposits very much reduced in size in both shoulders.

I always have both shoulders examined by *x*-rays even though symptoms are present on one side only. In 5 cases that I recall the skiagrams were negative in the shoulder presenting symptoms and were positive in the quiescent shoulder. Each of these 5 patients had had prolonged symptoms with recent improvement and it is probable each of them had had a deposit that had undergone spontaneous absorption. We have one case of this type with us today. This bedfast patient is the mother of one of our interns. She was operated upon a week ago for a gynecologic condition. When she came to the hospital she gave a history of four months' symptoms of bursitis in her left shoulder. As you will observe these excellent skiagrams show a large deposit in her symptomless right shoulder and none in the left shoulder. Presumably she has had a deposit in her left shoulder which has absorbed spontaneously and she can look forward to complete disappearance of symptoms in the near future, but she does run the risk of developing similar symptoms in her left shoulder and if these are as severe as those she has had in the right shoulder we shall advise operation.

TREATMENT

Non-calcifying bursitis does not require operation. Its treatment is essentially the same as that of the non-operative cases of calcifying bursitis. The majority of surgeons who have written

on bursitis give preference to non-operative treatment even in the calcareous cases and only resort to operation in cases in which symptoms have persisted for weeks or months under medical care.

Codman, who was the first to describe subacromial bursitis in 1906, and myself are inclined to be more liberal in advising operation as the simplest, speediest, and surest method of effecting a cure. I usually let the patient make his own choice of treatment without urge on my part after stating various facts to him. The great majority of deposits which cause marked symptoms tend to undergo spontaneous absorption in the course of several weeks or a few months. Usually symptoms cease when absorption is complete but occasionally they persist in lessened degree or recur mildly for a year or longer after the deposit is gone.

Without operation a small percentage of the acute cases experience great improvement usually within two or three weeks and then symptoms continue in chronic or recurrent form. It is impossible to predict which cases will clear up and which will not, except the more acute the attack the more likely is the deposit to disappear quickly, but this is not invariable. I have known patients to have recurrent symptoms for more than twenty years.

Chronic cases are far less prone to clear up spontaneously unless they develop an acute exacerbation. In my opinion acute symptoms are due to an increased hyperemia which in turn is apt to cause absorption of the deposit. I am not convinced that any treatment expedites disappearance of the deposit. I, at one time, conceived the idea of feeding patients on a calcium-free diet to create a calcium-hunger on the part of the blood and thereby hasten absorption. But, alas, the biochemists informed me that all foods contain calcium and that my idea was impractical. Physiotherapists claim that diathermia causes absorption, but I have not been able to observe any benefit from it in my cases. In my previous paper I referred to Harris having claimed cured by diathermia, but he apparently referred to symptomatic benefit as he made no mention of follow-up skia-

grams. He has since reported 1 case with skiagrams before and after some thirty treatments with diathermia and it is interesting to compare his case with Fig. 5 in my paper. His deposit was smaller than mine and his showed only partial absorption in the same period in which there was complete absorption in my case which was treated by his physician only by the use of morphin to relieve pain. I do not recall the name of a surgeon who reported 7 cases of calcareous deposits all cured by the use of an adhesive plaster shoulder cap. The physiotherapists rather generally ignore nature's efforts at absorption and ascribe all improvement to diathermia. I hope some physiotherapist will try diathermia on a symptomless deposit as they are not prone to undergo spontaneous absorption and the real value of diathermia can therefore be determined. Injudicious massage and passive motion have been responsible for bringing on an acute exacerbation in several chronic cases that I have seen.

Operation in recent acute cases causes immediate cessation of bursitis symptoms, but the same brilliant result is not obtained in the chronic cases. Operation will immediately abolish the symptoms of the exacerbation, but will not promptly terminate the milder long-standing symptoms of chronic cases. The deposit needs to be removed in the prolonged chronic cases, however, in order to bring about ultimate relief. This rather constant difference in the results obtained by early and late operation is a rather strong argument in favor of operation during the acute state as the patient experiences complete recovery in less time than the acute crippling symptoms otherwise would persist. The individual, especially if he is a laborer, anxious to return to work at the earliest possible moment, had best be operated upon. The ladies who object to a rather unsightly scar on the shoulder usually prefer the longer and more uncertain outcome of non-operative treatment.

Technic of Operation.—Operation is simple and safe and free from any serious complications. It can be done under local anesthesia, but I usually employ gas-oxygen. The surgeon should acquaint himself before operation with the location of the deposit as determined by the tender area and by the *x*-ray.

An incision 2 to 2½ inches is made from the edge of the acromion down toward the insertion of the deltoid. This incision should correspond to the course of the deltoid fibers and for convenience is usually placed at the front of the shoulder. It need not immediately overlie the deposit as the latter can easily be brought under the incision by rotating the humerus. The incision is carried through the skin, fat, and deltoid fascia and then the deltoid fibers are separated from one another to gain access to the roof of the thin-walled bursa. With a little care the roof can be opened to permit inspection and palpation of the bursa. Many writers report total excision of the bursa, but this is obviously impossible without first dislocating the shoulder-joint. By manipulation, particularly pulling downward on the humerus, there is barely room to insert a finger into the space between the humerus and acromion to explore the bursa which is about the size of the patient's palm. Occasionally a deposit may rupture into the bursa, but I have never encountered an instance of it at operation. It cannot be too strongly emphasized that calcareous deposits normally are found beneath the floor of the bursa and not in the bursa itself despite frequent statements to the contrary that still appear in the literature. Unless the surgeon is aware of that fact he is apt to miss the deposit entirely. About four years ago Stern published a very plausible paper in which he reported several cases showing deposit shadows on which he had operated and found only fat tabs which he removed and which were completely soluble in ether and alcohol. There can be no question but that he completely missed the deposits in his cases, probably because he sought for them in the bursa or its walls rather than in the supraspinatus tendon. Real deposits are not soluble in ether, do not exhibit any fat under the microscope, and habitually show calcium on chemical examination.

The deposit usually can be seen or palpated through the floor of the bursa. Incision through the floor frequently enters the deposit but often the floor can be incised and peeled back and further incision made into the underlying supraspinatus tendon before entering the deposit. Exceptionally, when the

deposit lies on the deep aspect of the thick tendon, it can be neither seen nor palpated and it must then be sought by deep incision parallel with tendon fibers at the site indicated by the skiagram and localized sensitive area. At times these deep-seated deposits apparently project into a pocket in the humerus or into the depression just above the greater tuberosity.

The deposit may be single or multiple. Multiple deposits as found at operation may appear as a single shadow in the skiagram. I have seen hundreds of pinhead-size deposits which caused one homogeneous shadow. The consistency of the deposit may be fluid, mushy, or firm and gritty. The entire deposit should be removed. This often can be accomplished by spooning it out with a blunt curet, but often some of the infiltrated tendon needs to be trimmed away. Codman sometimes sutured the floor of the bursa into the defect of the tendon in order to augment the blood-supply to the latter. Some surgeons suture the floor and roof of the bursa and close the incision without drainage. I think patients should have a more comfortable and shorter convalescence if bursal sutures are omitted and a drain is inserted through the deltoid for two or three days. Beginning the first few days after operation patients should be encouraged to use their arm freely and employ special exercises to restore full range of motion.

Non-operative treatment requires morphin during the hyperacute stage and aspirin, salicylate compounds or other antineuralgic drugs for less acute pain. Pain in the majority of patients is benefited by local heat in the form of electric pad, hot-water bag, or diathermia, but the occasional patient obtains greater relief from an ice-cap. In cold weather, especially at night, sufficient clothing should be worn to keep the shoulder warm. Patients should be warned against any arm motions which produce or aggravate the pain as they tend to increase the inflammation. Moderate abduction with the arm resting on a pillow placed between arm and chest relaxes the supraspinatus and gives some relief especially at night. During the hyperacute stage patients voluntarily hug the elbow to the chest, but during the later stages when they resume work they

should be instructed to keep the elbow at the side of the chest. This may call for elevation of the floor or seat or depression of machine, piano, or work table. Chauffeurs should grasp the under surface of the steering wheel instead of the upper with the affected hand.

The tendency to habit contracture from holding the shoulder constantly in the abducted position should be combated by having the patient carry out once daily the maneuver described by Codman. The patient stands with knees kept fully extended and bends over to touch the floor with his finger-tips. This is the only painless method that can be used to bring the arm into full abduction. Some surgeons treat these shoulders in abduction at an angle in excess of 90 degrees. This is the ideal position for treatment, but it has proved too irksome for the patient for routine use in my cases. Judicious massage of arm and shoulder muscles, other than at the bursal site, lessens atrophy.

In late cases, after pain has subsided, special exercises may be required to overcome restricted motion due to contractures.

HISTOPATHOLOGY

I now take pleasure in introducing to you Dr. Case, who will tell us about the histopathology of some of these cases.

Dr. Case: The etiology and clinical features of this interesting and often disabling and painful condition have been thoroughly discussed by Dr. Carnett. Moschowitz, in 1915, studied 3 cases microscopically, and found tendon inflammation, necrosis, and calcification as the principal changes. My report is based upon the study of the tissue removed from twenty-six shoulders, twenty-three individual patients, all from Dr. Carnett's service, and tissue from seven shoulders, four individuals, removed at autopsy. The latter, serving in the nature of controls, were negative with two exceptions. One showed some evidence of a scattered mononuclear infiltration and tendon proliferation, and in the other some calcium had been deposited. So far as is known these autopsy cases suffered from no symptoms.

The sequence of changes in the tendon seems to be a primary interference with the blood-supply, never very abundant, and then ischemia and necrosis result. In this necrotic tissue are deposited calcium salts which can be shown by *x*-ray examination. In many instances, but not in all, an inflammatory reaction is excited. As the nutrition of the tendon is impaired the fibers involved undergo hyaline degeneration and often break up into fragments of varying size. This necrosis may occur in a number of foci, and in the

dead tissue calcium salts are deposited. In one case from 500 to 1000 such deposits were found. This deposit varies from microscopic amounts to collections of considerable size. It is often soft and cheesy, resembling caseation necrosis; sometimes it is fluid or semifluid like pus; and in other cases it is firm and brittle, necessitating decalcification before sectioning. Cultures show it to be sterile.

While only a few deposits were examined chemically, yet in no instance was fat found. They consist of some salt of calcium, the phosphate, oxalate, or carbonate. In one case, in addition to the calcium deposit, there was a separate focus which consisted of albuminous matter.

Histologically these yellowish or grayish deposits stain deeply with hematoxylin, and the calcium is precipitated in fine granules or larger masses or spherules. Often dead cells, giant cells, or bits of tendon become impregnated with the salts.

A most interesting finding was the development of bone and cartilage in one case. Two other cases contained areas suggesting early cartilage formation, and one early bone, but the appearance was not characteristic enough to justify a positive opinion. An examination of the specimen showed that the bone and cartilage development was not due to an injury of the periosteum, for it was definitely connected with and grew from the tendon, a typical metaplasia.

Wells states that " . . . any area of calcification is likely to be replaced by bone, no matter what tissue may be involved; apparently the presence of calcium salt deposits in any part of the body can stimulate the connective tissues to form bone, but in the absence of calcium salts even the cells which are normally osteogenic will not form bone."

In view of this, it is interesting that true bone was found in only one specimen, for it is fairly frequent in such conditions as phthisis bulbi and in the vessels in arteriosclerotic gangrene.

Several writers claim that traumatic rupture of the tendon with hemorrhage is the earliest lesion, but in this series of cases, hemosiderin was found only twice. The time elapsing between the initial lesion may have been long enough to permit the removal of the blood-pigment in some cases or hemorrhage may have been insignificant and played no part in its pathology. The development of inflammation does not alone result from the presence of calcium salt deposits, as may be seen in calcification elsewhere, and in a few of the specimens in this series. There is an added irritant such as the trauma of rapid or unusual movements of the shoulder.

This reaction varies in degree from the extensive formation of granulation tissue, as mentioned by Moschowitz, to the scattered infiltration of a few cells. As the lesion is non-infectious, there appears to be very little attraction for polymorphonuclears, though in 2 cases a considerable number were present. The lymphocyte, plasma-cell, and large mononuclear wandering cell (histiocyte) are the ones mostly concerned, and in many instances, foreign body giant-cells. With this cellular infiltration the fixed tissue cells respond by proliferation, adding the fibroblast to the cellular ensemble.

Where the cellular reaction is marked the picture closely resembles that of giant-cell tumor of tendon, if indeed it is not the same process. In one

specimen, this appearance led to the diagnosis of giant-cell sarcoma at the time of its removal (1915) for in addition to the cellular character of the lesion, the presence of mitosis and atypical blood-vessels proved to be very disturbing to the pathologist. These lesions are now looked upon as inflammatory rather than neoplastic and are believed to be benign. Incidentally this patient is living and free from recurrence fourteen years afterward. The following pathologic descriptions of three specimens are given to illustrate the types of tissue alterations found in this condition.

U. of Pa. 6084 L. K., 5/25/15: In the larger of two small pieces of tendon there is soft, yellow, friable, necrotic material.

Microscopically the tendon contains a number of areas of necrosis with calcification. These areas are irregular in outline, forming cavities filled with calcified material, the calcium salts having formed granules or masses of larger size. A few of these areas are surrounded by necrotic tendon, and are free from either a cellular exudate or the proliferation of the connective-tissue cells. However, most of them are part of a very cellular tissue which extends out into the living tendon insinuating itself between its bundles.

The cells are derived from the fibrous tissue of the part, from tissue wandering cells, and from the blood. The first are elongated, the nuclei vesicular, and the presence of mitotic figures indicates their activity.

The numerous tissue wandering cells are rounded, the nuclei stain well, and there has been a development of foreign body giant-cells. Lymphocytes and polymorphs are scattered through the tissue and represent the contribution from the blood-stream.

In these cellular areas the blood-vessels and spaces have thin walls and a small amount of hemorrhage has occurred.

A peculiar papillary arrangement has developed in some of the cellular zones, probably resulting from irregular necrosis leaving projecting processes of cellular tissue in the cavities filled with the deposit. Many cells have undergone necrobiosis and death and are calcified, retaining their rounded shape, forming the spherules commonly seen. The picture is that of a giant-cell tumor and its activity suggests malignancy, but at the present time, it is believed to be benign, an opinion confirmed by the subsequent history of the patient, *e. g.*, free from recurrence or metastasis fourteen years afterward. Two other cases presented a similar picture.

S. P. 5553. R. S., 7/15/1925.

1. Tissue from the interior of the subacromial bursa. It consists of polypoid processes of loose fibrous and fatty tissue infiltrated with numbers of lymphocytes, nononuclear wandering cells, and occasional plasma-cells. The outlines of the processes are mostly uneven, though portions are sharp and clear where the endothelial lining is preserved. Between the processes a small amount of a pink coagulum has lodged. The lesion is a polypoid bursitis.

2. Tissue from the roof of the bursa. This tissue is rather dense and shows both an inflammatory infiltration and a proliferation of the fixed tissue cells.

3. Deposit of thin pus-like material which soon assumed the consistency of soft cheese. Bacteriologically, it was sterile, and chemically it consisted of albuminous matter. This specimen is the only one containing albumin without calcium.

4. Supraspinatus tendon, divided into three groups. In A there is an inflammatory infiltration, tissue proliferation, some hemorrhage (which may be the result of operative trauma) and definite cartilage development.

Group B shows inflammatory changes and calcareous deposits.

Group C is particularly interesting, for in addition to the inflammatory phenomena and calcification, there is the formation of spongy bone.

5. Another portion of tendon showing the same type of inflammation, more marked in the looser tissue, with considerable calcification that proved to be calcium oxalate chemically. This case is of interest as it was the only one in the series in which actual bursitis was found by the microscope and where ossification as well as calcification had occurred in the tendon.

The next case illustrates the type where the evidences of inflammation are absent.

U. of Pa. 8895. In this tendon section, after staining with hematoxylin, there are irregular masses of deeply stained, dark blue, calcareous deposits occurring in granules of different size. Where these deposits occur the tendon tissue is "dead."

In addition to calcium salts hemosiderin has formed from previous hemorrhage. No cellular infiltration indicative of a reactive inflammation is present.

I am much indebted to Dr. J. B. Carnett for the privilege of studying these cases, and to Dr. Edgar N. Cowan and Mr. A. G. Keller, Jr., of the Chemical Laboratory for the chemical examination of the deposits.

CLINIC OF DRS. E. L. ELIASON AND DRURY HINTON

UNIVERSITY OF PENNSYLVANIA AND HOWARD HOSPITALS

CHRONIC DUODENAL ULCER

FEW diseases present the definite symptomatology and chronologic sequence of the same that are characteristic of duodenal ulcer of the chronic type. This is so often true that the diagnosis should be made in all but the exceptional case. In discussing these cases common use is made of the expression "ulcer facies," "ulcer type," and "ulcer triad." The patient with a duodenal ulcer is usually an adult male in the active, driving period of life. He frequently is excitable, easily worried, and often is living under some mental or physical strain. The facies often depicts this state as shown by horizontal furrows on each side of the mouth, a tense look to the jaw, and flattened cheeks. The upper jaw is often somewhat narrow and the upper median incisors project beyond the two lateral incisors. The angle of the mandible tends toward the acute type. The above is descriptive of the so-called ulcer facies. It must not be thought, however, that all ulcer cases have this lean and hungry look. Ofttimes the healthy, jovial, round-faced individual is a sufferer, although usually not to the same extent. Physically the patient suffering with an ulcer is the lean and long type, with a very acute costal arch and a low ponderal index, that is, his weight is below a normal average for his height—the "ulcer type." Contrasting this individual with the square-jawed, round, smooth-faced patient, with the four incisors on a line, a wide costal arch, and a high ponderal index, one straightaway thinks in terms of biliary disease as the most likely cause of right upper quadrant symptoms.

When the above described type of individual complains of pain beginning two to four hours after eating (hunger pain)

relieved immediately by the taking of food (food ease) or alkalin, and adds to this the history that his attacks of indigestion occur periodically, usually in cool weather, he is said to have the "ulcer triad," *i. e.*, food ease, hunger pain, and periodicity. Frequently the acute exacerbations of symptoms are associated with a period of overwork, worry, or physical exposure. Many other signs, symptoms, laboratory data, and facts in the history will be found in the vast majority of these cases. As these vary according to the pathologic changes we may divide the patients into four groups.

GROUP I

Under this heading are included those patients who never have experienced in the slightest degree any digestive symptoms until the catastrophe of a perforation of the ulcer occurs. These individuals are usually young, in the second or third decade of life, often robust and athletic. Because of the absence of all previous symptoms, the diagnosis is often mistaken and the patient is treated for renal colic, biliary colic, or appendicitis, and hence valuable time is lost before operation is decided upon. The following history is illustrative:

Case I.—M. B., male, nineteen years old, was well until 8 P. M. December 8, 1925. As he was alighting from a street car in front of the hospital, he was suddenly seized with severe epigastric pain. He was helped into the Receiving Ward, and treated for two hours as a case of "acute indigestion." He vomited once about 5 ounces of greenish fluid containing some undigested food.

Two hours later he was seen by a surgeon. Physical examination showed marked rigidity of the right side of the abdomen, marked tenderness over McBurney's point, and good peristalsis. The chest was normal and rectal examination negative. Temperature 96° F.; pulse, 96; respirations, 32; white blood-cells, 16,900.

A diagnosis of acute appendicitis was made.

Operation.—Under local anesthesia through a gridiron incision, the appendix was found with a somewhat injected serosa. It was removed. The appendiceal pathology was not considered sufficient to account for the turbid fluid and some gas bubbles that escaped from the abdomen. A diagnosis of ruptured peptic ulcer was made and the abdomen opened by a paramedian incision under local anesthesia. Much more cloudy fluid was discovered and several bubbles of gas escaped.

Gas-ether anesthesia was instituted and after aspirating the fluid from the subhepatic region, a large ulcer was found on the anterior surface of the

duodenum just beyond the pylorus. Through a match-sized perforation in its center, gas and bubbles of fluid escaped.

The ulcer was oversewed, the suture line being covered with omentum. Because the repair resulting from this oversewing of the ulcer seemed to produce a nearly complete stenosis of the duodenum, a posterior gastro-enterostomy was performed. The abdomen was closed after inserting a rubber tube in the subhepatic fossa.

Postoperative Course.—The first day after operation the patient vomited small amounts of bloody fluid, but he improved steadily after water was given by mouth on the second day. The drainage tube was removed on the eighth postoperative day, and the patient was discharged with a healed wound fifteen days after his admission.

Discussion.—This case is an example of the type of duodenal ulcer in which the first symptom is perforation. These cases are frequently misdiagnosed as was this one. With the perforation there may or may not be a leukocytosis, so that this symptom cannot be depended upon in making a differential diagnosis. Frequently the gastric or duodenal contents drain down the right side of the peritoneal cavity giving acute tenderness and rigidity of the entire right side of the abdomen. This symptom is often mistaken for the usual sign of appendicitis and cannot always be relied upon as this case shows.

The outstanding symptom of ruptured ulcer, acute, stabbing pain in the epigastrium was overlooked in this case.

On opening the abdomen the diagnostic signs are often found long before the ulcer is visualized. In early cases the injected serosa with peritoneal fluid in excessive amounts, and often with flakes of lymph floating in it, usually is characteristic, and easily distinguished from the homogeneous, murky pus found in the ordinary bacterial peritonitis. Often bubbles of gas escape making the diagnosis of ruptured viscus certain.

The treatment of early cases varies. Resection of the ulcer is rarely advisable. Often the best treatment seems to be a cauterization of the ulcer, followed by an exact oversewing. The question of performing a gastro-enterostomy is a matter for the operator's judgment. The state of the duodenum after the oversewing governs this to some extent. If sufficient lumen remains, the patient may often be closed without further operative work. If, in the operator's opinion, the lumen is so narrowed

as to be obstructed, a posterior gastro-enterostomy is performed, provided the patient's condition and the surgeon's experience warrant the added trauma and time necessary.

The question of drainage is one which must be decided by the surgeon. No fast rule can be laid down, but a consideration of the extent of peritoneal soiling, and the character of the fluid will help in this decision. If the perforation is small, and the peritoneal soiling is confined to a small area beneath the liver, or if the fluid in the peritoneal cavity is clear and watery, even though widespread, it is often safe to close these patients without drainage. If the fluid is widespread and filled with particles of food and mucus, drainage may be the safer procedure. In practically all late cases (rupture more than twelve hours old) it is safer to drain. *When in doubt, drain, as was done in each case in this series.*

Follow-up report: Perfect health since operation two years ago.

GROUP II

Here are found those cases of chronic ulcer with recurrent exacerbation of symptoms. Pain is the most marked symptom and it is daily, occurring from one to four hours after meals. It is described as boring, gnawing, biting, stabbing, burning—is often associated with hot aqueous and gaseous eructations, dyspepsia, and is relieved by food or alkali, magnesia, bicarbonate of soda, etc. The pain occurs with great regularity at night, usually before midnight. Pains later at night in our series were associated with the large callus ulcer. Again, pain may be negligible, evincing itself merely as a distress or heavy feeling.

It is usually in the right hypochondrium, about 1 inch to the right and $1\frac{1}{2}$ inches above the umbilicus. Sometimes it is in the epigastrium and may be referred to the back or even to the right iliac fossa. This latter pain possibly is a result of spasm of the ileocecal valve, causing intestinal colicky pains. Excessive smoking often exaggerates the symptoms. The appetite usually remains good and the patients frequently gain weight unless they are losing blood. Melena of the occult type is very common and severe hemorrhage occurs occasionally.

These patients frequently sleep fitfully and have unexplained nightmares. Routinely all the symptoms will disappear with, or even without, treatment, only to recur again after a few weeks or months. In the symptom-free interval the patient usually gains weight.

Physical examination of the abdomen usually reveals nothing, although occasionally slight rigidity of the upper right rectus abdominis muscle is present together with some tenderness. A test-meal usually shows a high acid figure. The *x*-ray will show a deformed duodenal cap, active peristalsis, and rapid emptying of the stomach. Vomiting rarely occurs unless purposely induced. Nausea is very infrequent. The following case history is typical.

Case II.—M. S., forty-three years, male, manager of a mill, began to have epigastric pain five years ago. The pain appeared one to one and a half hours after meals, was often associated with nausea, but without vomiting. It often appeared at night and was severe enough to awaken him from a sound sleep. Food seemed to give him some relief. An internist whom he consulted diagnosed his condition as duodenal ulcer and prescribed a dietary regimen which relieved his pain entirely for six months. Thereafter, however, at intervals, his pain would return as before. During the week before admission he experienced considerable discomfort after each meal, in spite of a restricted diet, and alkaline powders which he took. His consultant advised operative treatment.

He says he has been an excessive smoker for years.

Physical Examination.—Temperature, 98° F.; pulse, 84; respirations, 20. The patient is a well-developed male, inclined to be "heavy set." Teeth showed moderate pyorrhea and considerable dental work.

Abdomen—no areas of tenderness or rigidity, no masses palpable. Wide costal angle.

Examination otherwise negative, except for diabetes under control.

x-Ray Examination.—No six-hour retention. Stomach of steer-horn type, but no defects were noted in its outline. The fluoroscopic and plate examination showed a constant defect in a contracted duodenal cap. A diagnosis of duodenal ulcer was made.

Operation.—Nitrous oxid, oxygen, and ether anesthesia. Upper right paramedian incision. A large stippled ulcer was visualized about 1½ inches from the pylorus. The ulcer was excised with a cautery, and the defect oversewed. A posterior gastro-enterostomy was performed with some difficulty because of the immobility of the stomach.

Postoperative Course.—The patient did well until the seventh postoperative day when he became somewhat distended and belched frequently. The following two days he vomited large amounts of bile-stained fluid.

A fluoroscopic examination showed an obstruction of the jejunum beyond the gastro-enterostomy opening, and the next day practically all of the barium meal was still found in the stomach. The patient was given a gastric lavage which evacuated about 1500 c.c. of bile-stained fluid. On the eleventh postoperative day a second operation was performed under spinal anesthesia. The previous incision was opened. No evidence of peritonitis was found, but adhesions had formed which obstructed both the proximal and the distal loop.

After release the loops still appeared too sharply angled at the stoma due to marked thickening of the gastrocolic omentum around the opening for the anastomosis which seemed much narrowed. A gastrotomy was done and digital examination revealed a stoma narrowed to the size of the index-finger. Marked edema and induration seemed to account for this. A jejunojejunostomy was done and likewise a gastrostomy, passing the tube through the stomach, through the gastrojejunostomy stoma beyond the jejunojejunostomy into the distal loop for a distance of 10 inches, with the idea of feeding the patient and yet insuring rest of the operative site.

The wound was closed around a rubber tube drain placed at the operative site. At the close of the operation 60 c.c. of normal saline solution and 500 c.c. of citrated blood were given by vein.

The day following the operation, the patient was very weak, and belched frequently. A jute tube was inserted through the nose and drained large amounts of bile-stained fluid from the stomach. For three days this regimen was continued without marked improvement, in spite of the fact that fluids, NaCl, glucose, and peptonized milk were given through the gastrojejunal tube. The patient at this time was the picture of pancreatic asthenia—weak, with a leaky skin, slow pulse, and low blood-pressure. He was apathetic and complained of exhaustion, anorexia, and discouragement.

On the fifth day after operation, the fluid obtained from the jute tube was allowed to flow into the gastrojejunal tube to provide the patient with his normal secretions.

Improvement in the patient's condition dated from this day. He rapidly regained strength, and began to take food and fluids by mouth so that the jute tube was clamped entirely four days later.

The following day the jute tube was removed and the gastrojejunal tube one day later.

The patient was discharged twenty-six days after his first operation.

Follow-up.—Three months later he reports perfect health.

Discussion.—This patient represents the type of patient in which medical treatment over a long period has proved unsuccessful. He was not the commonly noted, thin "ulcer type," with narrow jaw and costal arch, but was inclined to be stout, with the wide costal arch so frequently associated with gall-bladder disease. His history and *x*-ray findings, however, were typical.

The indicated surgical treatment of the chronic non-obstructive type of ulcer is open to considerable debate, and is to be decided largely on the surgeon's ability and experience, and the conditions found at operation. When, in thin patients, the duodenum can be easily exposed, and assistance and previous experience justify the more extensive operation, resection of the ulcer or partial gastrectomy are to be considered. But when, as in this case, the operation is to be performed on a fat individual where technical difficulties are great, or when experience in intestinal surgery has not been great, it is safer to oversew the ulcer and perform a gastro-enterostomy.

Obstruction of the jejunum below the stoma is fortunately a very infrequent complication following gastro-enterostomy. The symptoms usually do not appear until several days after food and fluids have been given by mouth. Belching, upper abdominal distention, and vomiting are the usual signs. The important thing is to recognize the condition early as it is a high intestinal obstruction. The *x*-ray is of greatest value in making the diagnosis.

Early operative intervention is indicated once the diagnosis is made. In many cases the cause of the obstruction can be easily relieved, in others it may be easier to perform a second anastomosis above and below the obstruction. For this reason latterly a longer proximal loop is being used in this clinic. This facilitates such secondary surgery. The treatment here used with the insertion of a gastrojejunal tube was unusual, but proved efficacious in this case. The improvement noted almost immediately after the gastric drainage was returned into the jejunum is a striking example of the value to the body of the normal digestive fluids in contrast to the artificial fluids substituted for them.

GROUP III

The patients of Group II automatically graduate into this group as the ulcerative character of the lesion becomes more chronic, fibrosed, rigid, and contracted, the result of scar tissue. The stomach meanwhile has undergone hypertrophy. When this occurs the symptoms change. The pain becomes negligible

and loses its relation to food, although such foods as macaroni, cauliflower, cabbage, and rich pastries will necessitate a dose of soda or magnesia. Dyspepsia is slight and transient, food is no longer necessary at night, and local tenderness disappears, together with any slight rigidity that may have existed. Vomiting is still absent, but occasional slight and transient nausea exists. Gastric analysis frequently shows higher acid figures. The patient gains weight and finds that his upper abdomen has become more prominent. After a full meal there is a feeling of "bloating," or distention associated with gaseous eructations, sometimes excessive in amount and associated with borborygmi, and much flatulence, especially before breakfast. A crawling sensation, in the region of the pylorus, as well as over the ileocecal valve will be noticed. The *x*-ray will reveal an hypertrophied, "fighting," somewhat enlarged stomach, with a six-hour residue, hyperperistalsis, and a constricted deformed duodenum, with probably a filling defect, sometimes sufficient to warrant the diagnosis of ulcer threatening to perforate.

Exacerbation of symptoms and the appearance of a sticking or "catching" pain over the upper right quadrant indicate recrudescence of activity and should warrant early recourse to surgery. The two serious catastrophes that happen in these cases are perforation and hemorrhage. As over 90 per cent. of said accidents occur in chronic ulcers, their very appearance is evidence of someone's neglect in not insisting upon operation. The fact that 20 per cent. of chronic ulcers perforate and that between 2 and 3 per cent. of patients with hemorrhage die as a result of it, is reason enough for recommending operation most imperatively.

This type of case gives the best results following surgical intervention of the gastrojejunostomy type. The following case history is an excellent example of the above:

Case III.—G. H., male, aged sixty years, admitted to the hospital with chief complaint of gaseous eructation and epigastric distress. He states that several years ago he had recurring attacks of dyspepsia associated with a gnawing distress in his epigastrium relieved by glass of milk or bicarbonate of soda. He was *x*-rayed at that time and a diagnosis of duodenal ulcer was made. For several months his doctor washed his stomach out, at first daily

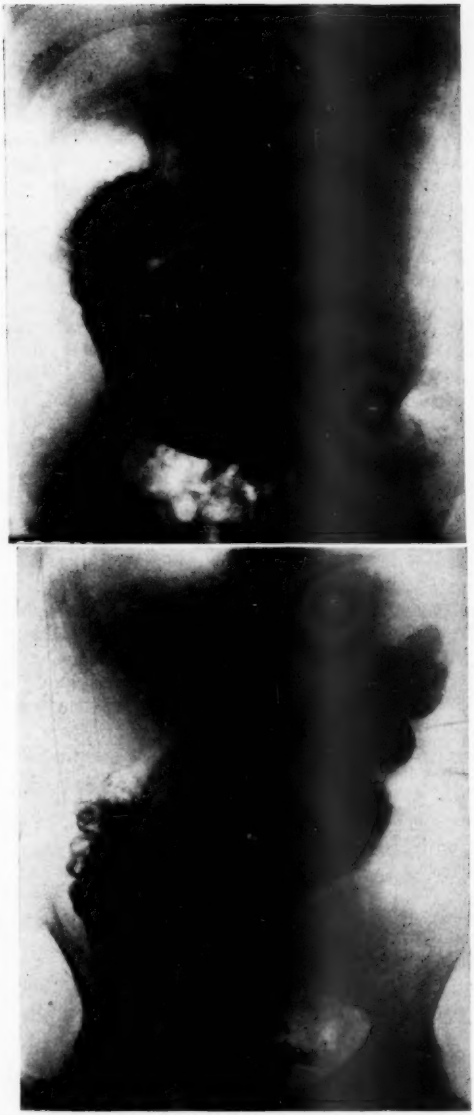

Fig. 407.—Case III. G. H. Note the enormous size of the enlarged stomach. It is the hypertrophied "fighting" stomach described in the text. Note the pyloric deformity also.

and later biweekly. This treatment with powder and diet relieved him completely until three years ago when he began to have fulness and distress in the abdomen, associated with belching and flatulence. He had several attacks of sharp sticking pains during a period of several months. This pain ceased and he now complains of fulness and distress after eating. He has noted swelling of his abdomen, although recently he has begun to lose weight. He has been nauseated and has vomited only once.

Physical examination is relatively negative, except the abdomen. This, although long and narrow, is distended when the patient stands. Very marked visible and audible peristalsis is evident. The gastric analysis showed a high acid figure.

x-Ray Report.—The stomach showed almost a complete six-hour residue. There was marked continuous hyperperistalsis, almost entirely antiperistalic. The motility was considerably less than commensurate. There was a wide pyloric space which persisted throughout the examination. *The duodenal cap was very large* and presented a normal appearance, although there was a basal cap defect.

Diagnosis.—Gastroduodenal ulcer with pyloric stenosis.

Operative Notes.—Under spinal anesthesia a right paramedian incision revealed an enormous stomach with thick walls. There was an ulcer ½ inch distal to the pylorus and marked cicatricial narrowing of the lumen. The ulcer was oversewed and a posterior gastrojejunostomy performed with a proximal loop of moderate length.

The patient had an uneventful convalescence with the exception of atelectasis of the lower lobe of the right lung. This cleared up promptly under the rolling-from-side-to-side treatment with encouragement to cough. He was discharged in excellent condition eighteen days after operation.

Follow-up report states that he is perfectly well with no symptoms.

Discussion.—This case needs but little comment. The picture was typical and the surgery clearly indicated. The convalescence was free of every disagreeable feature except the atelectasis, which occurred despite the breathing exercises.

GROUP IV

Should the Group III cases escape perforation and hemorrhage, they automatically fall into this group. Again the picture changes and the symptoms follow the pathologic change. The ulcer now has become cicatrized and the lumen of the duodenum narrowed. Adhesions bind and distort both the duodenum and the pylorus and obstruction is the dominant factor in the picture. The patient now begins to have a constant bloated, distressed feeling in the abdomen, associated with nausea, for which he soon produces emesis for relief. Loss of weight and constipation

appear, and soon vomiting occurs every second or third day. The vomitus will contain food taken the preceding day. Excessive thirst, a dry skin, and scanty urine make their appearance. Visible gastric peristalsis may be noted, although it will be reduced in frequency. Gastric lavage reveals a stomach content of several pints. The *x*-ray shows a decompensated stomach very much enlarged, with diminished peristalsis and having almost complete twenty-four-hour retention. When a case reaches this stage the acute catastrophes of ulcer rarely occur. This group, if treated surgically before dehydration or starvation has occurred, gives results nearly comparable to those of Group III. Case IV falls into this group.

Case IV.—Decompensated stomach with complete retention. F. S., male, age seventy-three years, a fruit grower, had always been well, except that he admitted after close questioning that he had always had a weak stomach. He had worked out-of-doors most of his life, and his eating habits had been regular until his wife died some years ago. Since that time he has cooked for himself.

Three months before admission, the patient first noted that he became distended after he ate and soon thereafter he began to vomit at frequent intervals. Gradually this symptom increased in frequency, from once every two or three days to once or more every day. The vomiting seemed to have no relation to meals, but he had a marked feeling of discomfort for a time before emesis which was relieved afterward. The vomitus consisted of watery mucus, contained fluid and never contained any blood. During the last few months he had lost considerable weight.

Physical Examination.—The patient is an old man, visibly weak, although mentally alert and co-operative. His skin is loose and the tissues flabby, giving evidence of marked dehydration.

Mouth—all teeth removed. Tongue dry.

Chest—marked emphysema, no râles.

Heart—sounds weak, no murmurs, occasional extrasystoles.

Abdomen—scaphoid, skin loose, no tenderness or rigidity. Liver palpable, no masses found.

Tentative Diagnosis.—Gastric neoplasm or obstructing duodenal ulcer.

Gastric analysis showed marked gastric retention and achylia.

x-Ray examination showed complete six-hour retention. Stomach was J shaped and little or no peristalsis was visible in the fluoroscope. There was a constant defect in the region of the pylorus which did not appear in the films.

x-Ray Diagnosis.—"Pyloric stenosis with complete six-hour residue and some dilatation; lesion uncertain but seems more likely to be ulcer in view of the absence of any marked pyloric defect."

During this period fluids were given in large quantities by proctoclysis and hypodermoclysis.

Operation.—Posterior splanchnic—local anesthesia. Right paramedian incision. An ulcer was found just distal to the pylorus with marked cicatricial contraction of the gut. No lumen could be palpated. A posterior gastro-enterostomy was performed. Before closure, the anesthesia of the abdominal wall was augmented by a second injection of novocain.

Postoperative Course.—The patient did remarkably well immediately following operation. After two hours, temperature 99.3° F.; pulse 96; respirations 20. He took fluids well, at first per rectum and under the skin, and then by mouth. He vomited but once. Peristalsis was good. At about noon on the third postoperative day he suddenly experienced pain in the right chest. He seemed weaker, temperature 101° F.; pulse 112; respirations 32, and coarse râles could be heard all over the chest posteriorly. Heart sounds were of poor quality. The following day percussion signs were present at the right base. Respirations increased steadily to 48. A diagnosis of pulmonary embolus was made.

Fig. 408.—Case IV. F. S. Illustrates the stomach after decompensation has occurred. Note the smooth outline free of peristalic waves.

The patient died the following day.

Discussion.—The patient is an example of a long-standing, untreated ulcer in which the symptoms caused by it were either slight or minimized and laid, as he says, to a "weak stomach." The ulcer led to cicatrix formation, which in its contraction produced gradually increasing pyloric stenosis, and in turn gastric hypertrophy, and finally dilatation. No amount of medical treatment could help this patient.

When vomiting has been a prominent symptom a careful preparation for operation is necessary. Fluids in large amounts (3000 to 4000 c.c. per day) should be given by rectum and by hypodermoclysis, of which saline and glucose solutions are the best.

The operation is best performed by the least shocking method. Local and splanchnic or spinal anesthesia is often indicated, especially in the older patients.

The operation of choice is a gastro-enterostomy since in these cases of chronic ulcer with pyloric stenosis it has given almost uniformly good results, with a considerably lower mortality.

The pulmonary group of complications in our experience is most common following operation for ulcer. The upper abdominal incision and tight dressings frequently employed often lead to decreased aëration of the lungs and since coughing gives considerable pain, the mucus, which is formed, is not expectorated, leading to bronchitis or bronchopneumonia, when an infective organism invades, or atelectasis when the mucus plugs a bronchial branch. The prophylactic treatment has already been described.

In older patients associated with an emphysema and myocarditis, hypostatic congestion or pulmonary embolus may occur.

Case V.—Perforated ulcer with multiple complications. G. H., age forty years, had suffered with attacks of upper abdominal pain for "many" years. The attacks came on one to two hours after meals, and were associated with gaseous and sour eructations. Food and soda had always relieved his pain. He had never sought medical treatment for his discomfort.

Early on the morning of October 9, 1927, the patient had a sudden attack of severe pain just above the umbilicus. He vomited, but was not relieved. An enema was given and returned with excellent results, and for a short time his pain seemed somewhat less.

Soon, however, the pain returned. It was constant, but every three to five minutes it seemed to become more severe. He vomited at intervals throughout the day. Relatives, mistaking his pain for the after-effects of a five-day "drunk," gave Pluto water and magnesium citrate, most of which returned in the vomitus.

He was admitted to the University Hospital on the evening of the day after his attack. He was evidently in great pain and resisted any attempt to move him. Every bump of the ambulance or litter brought agonizing groans.

Physical Examination.—Temperature 100° F.; pulse 128; respirations 24; blood-pressure 135/75.

Chest—narrow costal arch and shallow respiratory excursions. Moist râles were audible over the entire chest.

Abdomen—there was board-like rigidity over the entire abdomen, most marked in the epigastrium. Tenderness was especially noted in epigastrium and over McBurney's point. Peristalsis was diminished and there was slight distention.

Tentative Diagnosis.—Duodenal ulcer, ruptured thirty-six hours.

Operation.—Nitrous oxid-oxygen, local. Through a paramedian incision the abdomen was opened, disclosing the typical glairy edematous tissues associated with an "acid belly." The peritoneal cavity was filled with turbid fluid, and after aspiration a perforated ulcer was visualized about 1 inch from the pylorus on the anterior surface of the duodenum. The ulcer was oversewed, the abdomen irrigated with warm saline solution, and drainage inserted into the pelvis and into Morrison's pouch.

Postoperative Course.—During the first two postoperative days large amounts (3000–4000 c.c.) of fluid were given by hypodermoclysis and enteroclysis. On the third day, water and other fluids were given by mouth. Temperature 100° F.; pulse 90; respirations 24. His general condition was encouraging, but he began to become disoriented mentally, waking suddenly out of disagreeable and terrifying dreams. This symptom became more marked on the two following days, and a diagnosis of delirium tremens was made, based on the history of acute chronic alcoholism which was obtained from members of his family.

On the sixth day after operation the patient first complained of pain in the right ear, and on examination a tender swelling was observed in the right parotid gland. Hot moist applications were employed, and mouth washes and fruit lozenges were given to keep the mouth clean and promote salivary secretion. The following day the right parotitis was well marked and there was beginning tenderness on the left side. Delirium returned so that the patient had to be restrained. Peristalsis was good, however, and except for a slight amount of distention, the abdominal condition seemed to progress satisfactorily. White blood-cells were 6300. Bilateral incision and drainage under local anesthesia were performed for the parotitis. The patient next developed a diarrhea which persisted with four to eight watery stools for ten days. There was no pelvic abscess demonstrable, and the patient was treated by regulating and reducing the liquid diet (milk and cream) with the addition of bismuth. The frequent bowel movements and the retention of one position in bed had produced a beginning decubitus ulcer.

Following operation the temperature never reached normal, and in spite of careful examination, it was not until the twenty-seventh postoperative day that a limitation of motion of the right diaphragm was noted, and deep intercostal percussion posteriorly produced pain. An *x*-ray confirmed these findings, showing a high right diaphragmatic dome, with a collection of gas beneath and a definite fluid level (Fig. 409). Under local anesthesia a piece

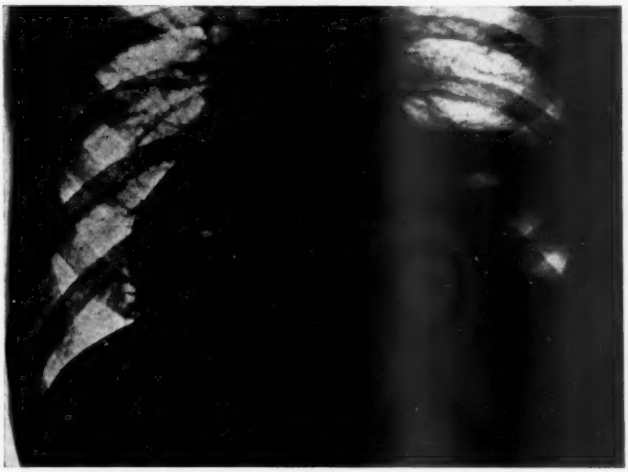

Fig. 409.—Case V. G. H. Illustrates the high diaphragm and the fluid level of the subdiaphragmatic collection. This patient's ulcer perforated thirty-six hours before operation and this *x*-ray was taken twenty-seven days after operation.

of the tenth rib was resected in the posterior axillary line. The costophrenic sulcus was obliterated and the abscess, located by a needle, was aspirated and drained through an opening made with a cautery.

The patient was discharged sixty days after his admission.

Follow-up report: The patient is entirely recovered and is in perfect health.

Discussion.—This patient represents one of long-standing ulcer with no trial of medical treatment. On the contrary he aggravated his condition by frequent alcoholic debauches, to which habit can be partly laid his late admission to the hospital.

The widespread moist râles in his chest are common findings in the late cases of ruptured ulcer, and often predispose to pul-

monary complications unless special precautions are taken to avoid them. One such prophylactic measure which we have used with considerable success is to have the patient take ten full inspirations (widely expanding the lungs) every hour when awake.

The operation and operative findings were typical of "old" perforation, and even before the peritoneum was opened the characteristic glairy edema was noted in the peritoneal tissues.

The operation indicated in the late cases is *the least that can be done to close the perforation and preserve the lumen of the intestinal canal.* If at all possible, only an oversewing of the ulcer should be performed. Drainage is practically always indicated.

The postoperative course of this patient presents some unusual and some more or less common complications which follow operations for duodenal ulcer.

Delirium tremens as a postoperative complication is becoming more and more rare. It should not be overlooked, however, especially in patients who give a history of chronic alcoholism.

Diarrhea may occur following operations where too large a stoma is made in gastro-enterostomies and in some patients following a liquid diet, especially one high in fat. The ordinary postoperative diet for these cases, in which cream is used to supply the caloric requirements is a good example. A reduction of fat and an increase of soft carbohydrates often is of benefit.

The facts which most often seem to predispose to the development of acute parotitis are: (1) An acutely ill patient, (2) poor teeth and pyorrhea, (3) liquid diet for a considerable period of time, and (4) mouth breathing, incident to toxemia or narcosis.

All of these facts are often present following an operation for duodenal ulcer and especially one for ruptured ulcer.

The prophylactic treatment is therefore indicated for nearly every case. When practicable the teeth and gums should be thoroughly treated before operation and most cases of duodenal ulcer need this treatment. Frequent mouth washes both before and after operation should be insisted upon. In the acutely ill patient a moist gauze over the mouth or swabbing the mouth

with a mixture of equal parts glycerin and lemon juice often prevents the dry mouth associated with mouth breathing.

The necessity for a liquid diet makes it imperative to stimulate salivary secretion by some artificial method. The use of chewing gum or even paraffine wax, alternating with fruit lozenges is routine. Hot applications in the shape of old-fashioned flaxseed poultices bandaged over the gland and kept warm with a hot-water bottle are employed. Gently stroking on the outside of the cheek along the duct line will frequently dislodge the dried plug of pus from the duct opening and permit sufficient drainage. Incision is indicated as soon as it can be determined where the abscess is located.

Subdiaphragmatic abscess should be suspected in every case of ruptured ulcer with continued septic symptoms. The diagnostic points were well demonstrated in this case—high fixed diaphragm, tenderness on inter-rib percussion, and of confirmatory *x*-ray findings. After locating the abscess with an exploring needle, drainage is indicated, preferably transthoracic in type.

ANALYSIS OF 137 CASES

The following data were obtained from the senior writer's service in the University of Pennsylvania and the Howard Hospitals. In the last six years 137 cases of chronic duodenal ulcer were operated upon by the authors and one other member of the staff. This series does not include reoperations nor cases complicated by other serious surgical conditions, such as carcinoma of the stomach, carcinoma of the gall-bladder, subhepatic abscess secondary to an old ruptured ulcer, nor those cases too ill to be operated upon. It does include 4 cases of double ulcer.

Only 19 of the 137 cases were females. The second decade of life accounted for 20 per cent. and the third and fourth decade for 60 per cent. of the cases. Of acutely perforated cases, 9 of the 32 occurred between the years of twenty-one and thirty and 10 of the 30 were between the years of thirty-one and forty.

Pain.—The most common symptom was pain. It occurred in 103 cases in the series and in all but 21 was described as of the hunger type and appeared one to four hours postcibal. In

only 8 of the unruptured cases was it described as severe. It was usually spoken of as a gnawing, dull, or aching type of discomfort. In 80 of 108 noted cases, it was described as being in the right epigastrium. Pain in 60 per cent. of the 103 cases was relieved by food or alkali. Vomiting occurred rarely. Even in the 30 perforated cases it is noted in but 7 instances. This infrequency is significant from the standpoint of differential diagnosis from appendicitis, biliary colic, and acute pancreatitis, in all of which vomiting is a prominent finding as a rule. Hematemesis occurred in 9 cases and melena in 5, and both in 7 cases, a total of 21 in the series. Loss of weight was experienced in but 26 cases.

Periodicity or more or less regular recurrence of symptoms was definitely noted in 89 patients. It was stated as absent in 15. In the other 26 it was considered absent or unnoted.

Systematic medical or dietary treatment had been given to only 28 of the patients. This is a step in the right direction and may be taken as evidence that physicians have joined ranks with the surgeons in considering all chronic duodenal ulcers as requiring surgical treatment. When this attitude is generally accepted the unpleasant and unfortunate complications of hemorrhage, perforation, and death will be greatly reduced.

The physical appearance as noted was misleading in many cases if one be inclined to expect the patient always to be of the ulcer type, as described above. Of the 109 cases in which a notation had been made, 57 were described as good, 4 as obese, 23 as emaciated, 14 with the ulcer facies, and 10 as in shock.

Tenderness was noted as being present in 48 of the unruptured cases, and in 28 of the ruptured cases. In 13 of the latter, tenderness was definitely stated as being general in character.

Rigidity was mentioned in only 14 of the unruptured cases and in 29 of the ruptured group.

x-Ray examinations were made on all the chronic cases when possible. In only 11 cases was a doubtful or negative report returned in cases in which ulcer was later found at operation.

Recently *x*-rays and a fluoroscopic examination have been made as an aid to diagnosis in the ruptured case. Such an examination will frequently reveal a fixed diaphragm with demonstrable gas beneath each dome.

Anesthesia varied widely as to type. The earlier operations were done under ether anesthesia. Until recently this was the anesthesia of choice for all perforation cases, on account of the relaxation obtained and also because of the fact that many of the perforation cases were operated upon at night when an intern anesthetist, untrained in gas or ethylene anesthesia, was on duty in the absence of the professional nurse anesthetist. At a later period local anesthesia with supplementary postsplanchnic infiltration was used. Lately spinal anesthesia is being used more frequently.

Operation.—The type of operation varied but little. In 95 of the non-perforated cases a posterior gastrojejunostomy with plication, excision, or cauterization of the ulcer was performed. In the early cases a short loop anastomosis was performed, but in the more recent operations a proximal loop from 4 to 5 inches in length was left. This was done so as to render any future surgery on these structures of easier accomplishment in case of obstruction, marginal or jejunal ulcer. In only 6 cases was excision and a pyloroplasty performed. These were all recent cases. In the perforated cases a posterior gastrojejunostomy, with suture of the cauterized perforation further protected by an omental flap, was performed in 21 patients. Eight patients had only cauterization and suture of the perforation. Only one anterior gastrojejunostomy was done.

Postoperative complications were of 25 types, a few of which will be mentioned. Pulmonary complications head the list, there being 6 cases of bronchopneumonia, 3 of lobar pneumonia, 3 of acute bronchitis, 1 of atelectasis, 1 of pleurisy, and 1 of embolus.

Postoperative hemorrhage occurred in 4 cases, none of which, however, resulted fatally. Bilateral suppurative parotitis and subdiaphragmatic abscess each occurred once, both being in the same patient, whose ulcer had perforated thirty-six hours be-

fore operation. This patient recovered. Postoperative gastric tetany occurred in one patient with almost complete obstruction and daily vomiting for weeks before operation. Through an oversight an overamount of bicarbonate of soda was administered by clysis and precipitated the attack. A hypodermic dose of 10 c.c. of a 5 per cent. solution of calcium chlorid immediately overcame the difficulty. This mishap has served its purpose with us in that soda is withheld in all cases who have had a long period of vomiting. The solution is 5 per cent. glucose in salt solution, together with 2 fluidounces of tincture of digitalis given together by bowel.

Jejunal ulcer was positively demonstrated in only 1 case. This figure should probably be higher but our follow-up service did not reach some of the cases. Doubtless more have occurred. Obstruction at the opening through the gastrocolic omentum occurred in 2 cases. Both recovered after a second operation. One of the reported case histories gives a very interesting account of one of these patients. In both cases the stoma was constricted by reason of the excessive infiltration in the gastrocolic omentum surrounding it. Feeding by the jejunum for ten days resulted in recovery.

There were several wound complications, including three severe infections, one of which was associated with scarlet fever and streptococcic peritonitis. There were 2 cases of cerebral complications and 1 of heart-block. Phlebitis occurred but once. Delirium tremens was present in 2 perforated cases. One survived despite a subdiaphragmatic abscess and the other died. The second case had been intoxicated for five days and the perforation had occurred nine hours before operation. This patient stopped breathing on the table three times and died shortly after the operation was completed.

Acute perforation of an ulcer is a terrible catastrophy. The patient experiences a sudden agonizing pain in the upper abdomen. It is so severe that in the majority of cases it results in local as well as general muscular fixation. The patient will not move as a rule, but remains "frozen," usually in the sitting position. One of this series had a perforation at his desk on night duty in

an office. When found three hours later he was still seated at his typewriter leaning over with his head on the machine and his forearms doubled over and pressing upon his abdomen. Another patient had his perforation at 2 A. M., just as he sat up in bed. When seen at 6 A. M. he was in the same position, leaning over and pressing his forearms into his abdomen. This fixation or "frozen" attitude is characteristic and contrasts strongly with the extreme restlessness seen in renal and biliary colic, in the early stages of acute appendicitis, and to some lesser degree in acute pancreatitis. The perforated ulcer patient resents being handled or moved. Abdominal rigidity is "board-like," and because of this protection gentle palpation reveals merely moderate tenderness. Later the tenderness becomes marked and often is most evident in the right iliac fossa, thus accounting for the mistaken diagnosis (2 cases) for acute appendicitis. Vomiting is not a prominent symptom. It occurred spontaneously in only 7 of the 32 cases. In a few others it was induced and in neither type was it repeated.

Prostration is extreme and rapid in its appearance. This condition has been described erroneously in the literature as "shock." It is not shock in the accepted surgical sense. Although the patient looks desperate and shows a pallor, anxious expression, and a clammy skin, yet his pulse will be normal or slightly above normal in rate and his blood-pressure will be within normal limits. This appearance was present in the records of only 10 of the 30 cases. The average temperature was 98° F. and the average pulse-rate was between 80 and 90, the highest being 110, on admission. Blood-pressure when taken usually varied slightly from the normal, the lowest being 110 systolic. The prostration lasts for a variable period, becoming less evident as the first few hours pass.

Peristalsis was diminished in all cases and reported as absent in 20.

Leukocytosis was found of little help. The lowest was 4800 and the highest 20,000, the latter in a case operated upon within two and one-half hours. When the diagnosis was in doubt,

Fig. 410.—This patient's ulcer perforated five hours previous to this photo. Note the gas crescents beneath the diaphragm on each side.

Fig. 411.—Note the narrow gas shadow just under the right dome of the diaphragm. This patient did not have a ruptured duodenal ulcer, but had had a slow perforation of the gall-bladder.

an *x*-ray was taken. In 2 cases it revealed gas-caps beneath the two domes of the diaphragm.

Figure 410 shows this condition very clearly. This patient's perforation occurred five hours previous to the time this photograph was taken. Fluoroscopic report was to the effect that there was no diaphragmatic movements.

Gas beneath the diaphragm may be secondary to other conditions as illustrated by the following résumé of a case of duodenal ulcer (Fig. 411), not in this series because of complications.

M. W., female, age forty years, came to the Out-patient Department complaining of loss of weight, weakness, and some cough. An *x*-ray was taken of the chest and the report was that there was a fixed diaphragm with gas under the right dome. The patient was at once admitted to the hospital because of a suspected perforation of an ulcer. The *x*-ray showed a six-hour residue, with continuous hyperperistalsis, but absolutely no motility. The stomach was dilated and the phenomena suggested a pyloric obstruction. The second fluoroscopic examination ten hours later still showed the barium chiefly in the stomach. At forty-two hours there was residue in the stomach.

Summary.—Pyloric obstruction. In view of the gas under the right diaphragm there has probably been a rupture of an ulcer.

Operative Notes.—Through a right rectus incision the pylorus was exposed and a large callus ulcer was found, 1 cm. distal to the pylorus. Dense adhesions were present between the gall-bladder and second portion of the duodenum at a point 1 inch distal to the ulcer. Dissection disclosed a much thickened and contracted gall-bladder which had perforated, discharging a small stone against the duodenum which, however, did not show ulceration at this point. The common duct was opened and four large stones removed. The common duct was drained through the cystic duct. The only explanation of the gas under the diaphragm was as a result of the old perforation of the gall-bladder although there was no evidence of a duodenal perforation. Exploration of the upper surface of the liver showed no evidence of gas or adhesions. The duodenal ulcer was oversewed and a posterior gastrojejunostomy performed. The patient now, six months later, is entirely well and gaining weight.

The second case (Fig. 412) of gas under the right diaphragm was found in a patient whose history abstract follows:

Male, age fifty years, admitted to the University Hospital with the chief complaint of a severe pain of five or six hours' duration in the right upper quadrant of the abdomen. The temperature, pulse, and respiration were normal and physical examination revealed tenderness and rigidity over the gall-bladder. The leukocytes were 16,000. An *x*-ray was taken for gas under the diaphragm secondary to a suspected perforated ulcer. At operation, the

gas under the diaphragm was found to be in the colon which lay immediately beneath. There was no liver under the right diaphragm nor indeed on the right side of the abdomen, probably a congenital condition. It lay entirely on the left and apparently in a longitudinal, rather than in its transverse or

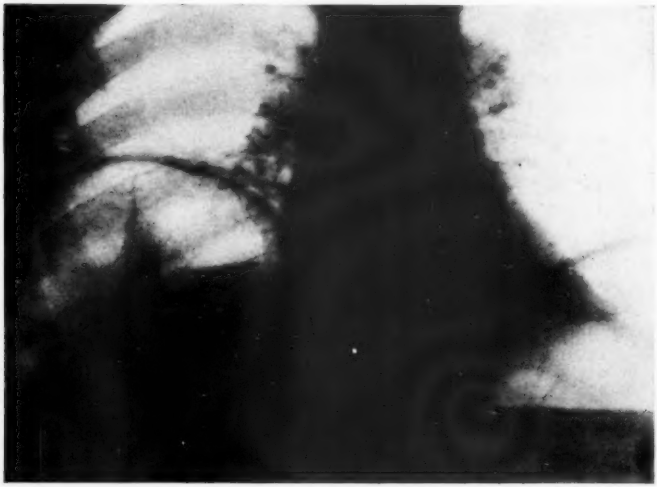

Fig. 412.—Note the enormous collection of gas under the right dome of the diaphragm which on the wet plate reading was considered indicative of a ruptured hollow viscus. The reading of the dry plate following the congenitally displaced liver found at operation, was to the effect that the gas was in the colon. The large fluid level on the left is in the stomach.

vertical position. The pancreas was drained and the patient did well for four or five days when he experienced an attack similar to his previous one and died two days later. Autopsy revealed a second area (not present at the first operation) of recent gangrene affecting the tail of the pancreas, the probable cause of death.

Mortality.—Since the statistics were compiled on the above 137 cases, three cases of perforated ulcer can be added, making the total 140, which may fairly be used in mortality determination. In the 105 non-perforated chronic cases unassociated with other serious complicating disease, such as acute cholecystitis, pancreatitis, subdiaphragmatic abscess, there were five deaths, a mortality of 4.7 per cent. (3.8 per cent. if one table death from anesthesia is

excluded). In the 35 cases of perforated ulcer there were nine deaths, a mortality of 25 per cent., making a total mortality of 10 per cent. The time that elapsed in the perforation cases had a direct bearing in most instances upon the outcome of the cases that died, the average lapsed time between perforation and operation was twenty-three hours, and of the recovered cases the average lapsed time was eight hours. Of course there were a few cases that lived, although operated upon in the second twenty-four-hour period and also one in the third day. Two cases succumbed, although operated upon within three hours after the perforation.

In analysis of the deaths it will be noted that in 3 of the cases an unavoidable complication was the inferential cause, 1 had an embolus, 1 an early (four-day) rupture of the wound, and the third an inspiration of vomitus, resulting in asphyxia.

The rupture of the wound was a result of too rapid absorption of catgut, there being no trace of suture material found in the wound at the time of rupture.

The apparent frequency of postoperative pneumonia will bear a little explanation. Exceptionally was this other than a clinical diagnosis made usually within twenty-four hours of death and it should be classed as a terminal complication and actually should not be considered causative of death. The symptoms were those of a compression of the organ with signs of lack of aëration and consolidation. In no case was it a frank pneumonia picture clinically, *i. e.*, chill, bloody sputum, etc. In but one instance was the clinical diagnosis confirmed by postmortem examination.

The case of death on the table also requires explanation. This was in a negro whose anesthesia had been very stormy and difficult. Death was primarily a respiratory one. After the heart action had ceased longer than five minutes, he was resuscitated with intracardiac adrenalin and bimanual massage by means of a hand in the abdomen and two fingers in the chest through a separate wound. The pulse returned fitfully at first and in a few moments became regular and could be counted at the wrist. Despite all efforts respiration could not be re-estab-

lished, although the pulse actually remained present for six minutes.

In the obstruction cases early ileostomy was done in the left lower abdomen, using the Witzel method under local anesthesia. In one case this was repeated for ileus duplex. Instillation of hypertonic salt through the tube was used, with advantage in one case.

A point that is of utmost importance in the immediate results of operation is the patient's mental condition. Most of them are

FATAL CASES

	Perforation.	Hours between operation and death.	Complications.	Chief autopsy findings.	Cause of death.	Length of life after operation.
1	+	48	Pneumonia and peritonitis.	Bilateral lobar pneumonia, diffuse pneumococcus peritonitis.	Toxemia.	12 days.
2	+	5	Intestinal obstruction.	.....	Toxemia.	24 days.
3	+	3	Pneumonia.	.....	Myocarditis.	3 days.
4	+	7	Intestinal obstruction.	Secondary peritonitis, due to obstruction duodenitis.	Ileus duplex.	7 days.
5	+	30	Acute cardiac failure.	Postmortem revealed no cause.	.....	Death on operating table.
6	+	9	Postoperative psychosis.	.....	Shock.	3½ hours.
7	+	8	Pulmonary embolus.	.....	Pulmonary embolus.	29 hours.
8	+	70	Intestional obstruction.	Intestinal obstruction, peritonitis endocarditis.	Pneumonia and peritonitis.	3 days.
9	+	9	Shock.	.....	Shock.	Minutes.
10	−	8	Sudden acute respiratory and circulatory collapse.	.....		30 hours.
11	−	0	Rupture of wound.	Negative for peritonitis or intestinal obstruction.	Shock.	5 days.
12	−	0	Scarlet fever.	Streptococcus peritonitis.	Toxemia.	4 days.
13	−	0	Pneumonia.	.....	Cardiac secondary to pneumonia.	4 days.
14	−	0	Slight hemorrhage.	.....	Inspiration of vomitus.	5 days.

high-strung, nervous, and frankly frightened before operation. At times they will seriously state that they are going to die. I have never seen the prophecy fail. They begin their ordeal in a state of mental shock. This fright and apprehension figured prominently in two of the deaths.

FOLLOW-UP REPORT

The figures 4.4.4. each represent 100 per cent., the first anatomic, the second economic, and the third, functional results. In interpreting the report it must be borne in mind that many of these cases have been operated upon only a few months ago and none more than six years.

CHRONIC NON-PERFORATED CASES

Result.	Number of cases with follow-up report.
4.4.4.	56
4.3.4.	5
4.3.3.	1
4.2.4.	1
4.2.2.	1
4.0.0.	1

Reports were obtainable in only 65 of the 105 cases.

Considering the first two groups as favorable, it is fair to state that good results were obtained in 93 per cent. of the cases.

Of the perforated cases only 19 of those that recovered could be traced. These all had 4.4.4. reports with one exception, which developed jejunal ulcer at two different times with perforation each time, making a morbidity figure of 0.5 per cent.

In the entire group of recovered cases favorable (4.4.4. to 4.3.4) results were recorded in 93+ per cent. of the patients upon whom follow-up data could be obtained.

CLINIC OF DR. FRANCIS C. GRANT

FROM THE NEUROSURGICAL CLINIC OF DR. CHARLES H. FRAZIER, UNIVERSITY HOSPITAL

A CLINICAL STUDY OF MIDLINE CEREBELLAR TUMORS IN CHILDREN

IN a recent review of the cases of cerebellar tumors in children passing through the Neurosurgical Clinic in the University

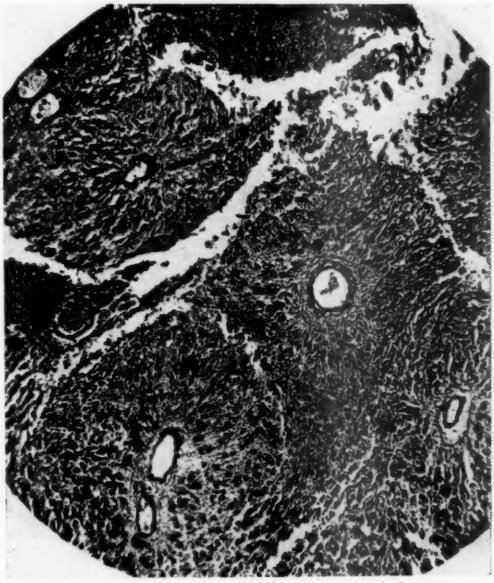

Fig. 413.—Microphotograph of tissue removed from Case I. H and E staining (× 160). Note pseudorosette formation typical of medulloblastoma, irregularity of cells, type, and marked vascularity of tumor.

Hospital, the frequency with which these tumors were found in the midcerebellar region was striking. Furthermore, the ma-

jority of these tumors in this location were of one pathologic group, the medulloblastomas. Since, therefore, one certain type of neoplasm appears to originate in a particular area of the cerebellum, it seems worth while to consider the clinical features connected with a tumor of this variety in this location. Are these symptoms of such uniformity that their appearance justifies a preoperative diagnosis of the position and type of the

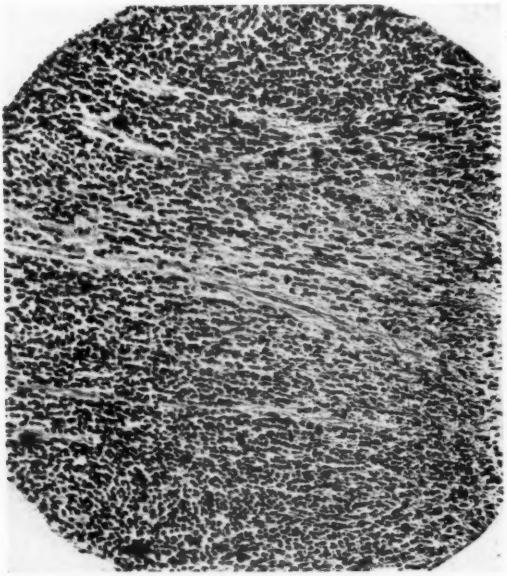

Fig. 414.—Microphotograph material removed from Case II to show palisade formation of cells in medulloblastoma. H and E staining (× 160).

lesion? If such a diagnosis may be made with certainty, what is the proper treatment and the prognosis?

This report is based on a series of seventeen children harboring tumors verified as medulloblastomas. The term "medulloblastoma" has recently been adopted by Bailey and Cushing in their regrouping of the glial tumors, based on the staining reactions developed by Cajal and Hortega. In all the cases here recorded the lesion was situated in the midline between the

cerebellar hemispheres and arose from the roof of the fourth ventricle. These tumors seem on gross examination fairly well circumscribed, but more detailed study always reveals areas of infiltration in the surrounding cerebellar tissue. Microscopically, the predominant cell is irregularly round or oval in shape, with scanty cytoplasm and large oval nucleus containing abundant heavily staining chromatin material. On low power study the cells appear as a loose structureless mass, in areas forming pseudo-rosettes, or elsewhere arranged in strands suggesting a spindle-cell sarcoma (Figs. 413–415). Blood-vessels are numerous; much of

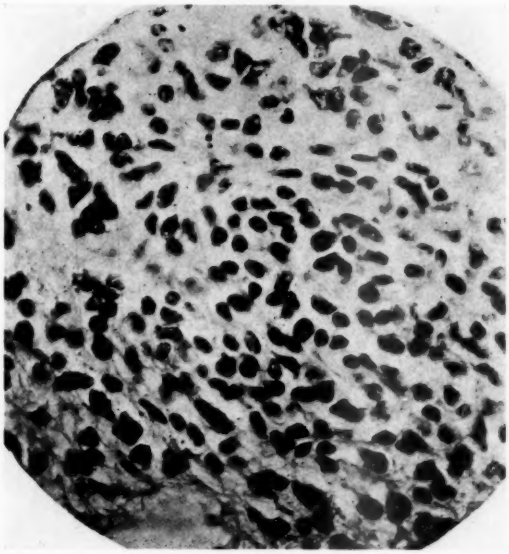

Fig. 415.—Microphotograph material removed from Case II. H and E staining (× 627). Note irregular type of cells, heavily staining intracellular material with nucleus, typical of medulloblastoma.

the fine connective-tissue stroma of the tumor is confined to their walls. Mitotic figures and other evidences of rapid growth are easily demonstrable. By proper staining methods with Hortega's fourth variant, both spongioblasts and more highly differentiated cell types may be identified, and the internuclear material

shown to be made up largely of the processes of embryonic glia cells.

The 2 cases here reported are typical of the clinical picture these children present.

Case I.—Frank B., M. W., eight years old.

Chief Complaint.—Headache, vomiting, failing vision.

Seven months ago severe frontal headache began, being especially severe in the morning. These headaches were accompanied by spells of vomiting. After an attack the patient would fall into a deep sleep for one or two hours.

Fig. 416.—Case I. Note box-like head with distribution of adipose tissue, suggesting Frohlich's syndrome.

Four months ago diplopia developed and at this time loss of vision was first noted. His parents stated that his left eye tended to turn in slightly.

Three months ago he commenced to seem clumsy in his gait, to fall easily, and to stagger when he walked.

There is no history of motor or sensory involvement or of convulsive seizures.

Past medical and social history irrelevant.

Neurologic examination revealed a chunky, rather fat child, intelligent and co-operative. The skin seemed unusually soft, warm, and smooth. No pubic hair was evident. While there was no unusual distribution of fat, the child undoubtedly tended toward adiposity. The genitalia were suggestively small. Although no striking evidence of endocrine dysfunction was noted, nevertheless, the whole make-up of the child suggested hypopituitarism.

Cerebrum.—No symptoms pointing to the involvement of the motor or sensory systems noted. Insufficient eyesight remained to obtain visual fields. The reflexes were all absent.

Cerebellum.—The gait was unsteady with a definite widening of the base in walking. He could not stand on either foot alone. There was some ataxia

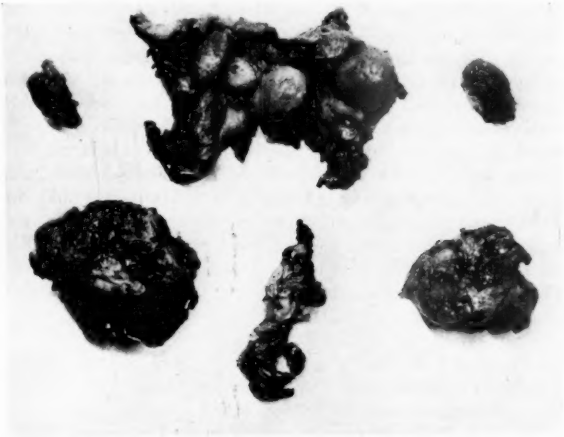

Fig. 417.—Tumor tissue removed from Case I.

and dysmetria in finger-to-nose and heel-to-knee tests. Bilateral adiadokokinnesis was observed but no past pointing. No nystagmus was noted. Marked hypotonia was present.

Cranial Nerves.—Except for the optic nerves, the cranial nerves showed no abnormalities. The sense of smell was preserved on both sides. The child was completely blind in the left eye with preservation of light perception only in the lower right quadrant of the right eye. There was a bilateral optic atrophy, presumably postpapillitic, in each eye. The ocular rotations and reflexes were normal. The absence of nystagmus must again be emphasized. Spinal tap was not performed. The *x*-ray studies revealed marked erosion of the dorsum sellæ with disappearance of the clinoid processes. Convolutional atrophy and separation of the sutures were reported.

Comment.—This child afforded a very interesting problem in diagnosis. From the neurologic findings the tumor might be cerebellar; from the *x*-ray and endocrine viewpoint it could be suprasellar. Retinoscopic examination gave us no definite clue as to whether the optic atrophy was primary due to pituitary disease, or secondary following intracranial pressure. The cerebellar symptoms could be caused by increased intracranial pressure. But pituitary tumors in children are most commonly of the Rathke pouch type and do not often cause internal hydrocephalus. Furthermore, these tumors frequently show calcification in the wall of the cyst. Nothing of this kind was reported from the *x*-ray studies. Had sufficient vision remained to perform perimetric tests the problem could have been solved at once, for a pituitary tumor produces a bitemporal hemianopsia. A posterior fossa lesion can bring about an erosion of the sella indistinguishable from that secondary to a suprasellar growth, by causing an internal hydrocephalus. As a result the third ventricle dilates downward into the sella and erodes the clinoids. In this case, inasmuch as the sense of smell was definitely unaffected, no calcification was seen adjacent to the sella, the cerebellar symptoms were well marked, and the presence of a posterior fossa lesion might account by pressure for the endocrine and *x*-ray findings, a diagnosis of midline cerebellar lesion was made. It should be noted that the absence of nystagmus did not prevent the localization of the tumor in this region.

A cerebellar exploration by Dr. Grant revealed a midline tumor springing from the roof of the fourth ventricle, microscopically a medulloblastoma. Enough of the tumor was removed to restore cerebrospinal fluid circulation by unblocking the aqueduct. After a rather stormy postoperative course the child recovered. Unfortunately, no return of vision followed. *x*-Ray treatment was instituted. This case emphasizes the necessity for early diagnosis so that operative intervention may occur before complete optic atrophy sets in.

Case II.—Ethel C., W. F., seven years old. Admitted 4/12/28. Referred by Dr. Burton Chance.

Chief Complaint.—Vomiting, headache, diplopia.

Present Illness.—Three months ago vomiting and severe frontal headache commenced. This condition continued for five weeks, the headache and vomiting being most severe in the morning.

Two months prior to admission she complained of diplopia and her parents noted that she had an internal strabismus in her left eye. She had fever, perspired freely, and stated that her right ear ached severely. No discharge from the ear was noted. At this time she had three generalized convulsions in which she was unconscious for about five minutes, and her muscles were spastic and contracted. No localized contractions were noted. Since this time she has been up and about, but it has been observed that she is becoming clumsy and walks with a wide base. She is dizzy, falls easily, and the frontal headaches have reappeared.

Past Medical History.—Normal, full-term baby, perfect health up to the age of two years. At that time had an illness of uncertain nature lasting five months, during which child was stuporous and vomited frequently. She

then recovered and was apparently normal, but had to learn to walk again. Her health has been excellent from that time.

Family History.—Irrelevant.

Neurologic Examination.—Examination revealed a co-operative, intelligent child with no particular complaint. No evidence of endocrine dysfunction was noted. The head was not enlarged. There was a suggestive cracked-pot sound and slight suboccipital tenderness. The cranial nerves were negative except for complete paralysis of the left VI and a choked disk

Fig. 418.—Case II.

of four diopters in either eye with fresh hemorrhages. Perimetric fields revealed concentric contraction in both eyes. The cerebrum functioned normally, no motor or sensory impairment being noted.

The reflexes were all absent. Marked hypotonia was present in arms and legs. While the gait seemed normal there was a definite lurch to the right in walking about a chair. Difficulty in standing with the feet in the tandem position was recorded, especially with the weight on the right leg. In the Romberg position she swayed definitely to the right. While adiadokokinesis

was marked in both hands, especially the right, the finger-to-nose and past pointing tests were well performed with both hands. The heel-to-knee test showed marked inco-ordination, especially with the left leg. A slight, flickering, horizontal nystagmus was noted on two occasions, but other observers failed to find it.

x-Ray studies of the head revealed convolution atrophy and separation of the sutures. The pituitary fossa was normal.

Comment.—In view of the sudden onset of symptoms, the age of the patient and the slight though definite cerebellar symptoms, a diagnosis of cere-

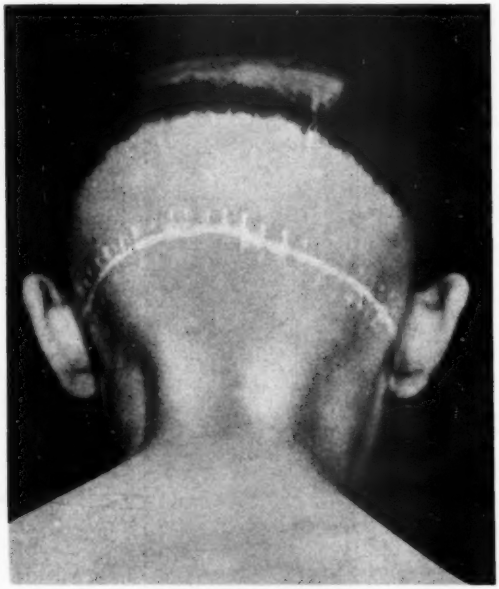

Fig. 419.—Case II. Note position of scar, straight cross-bow incision between the mastoids.

bellar tumor, probably in the midline, was made. However, since the symptoms were left-sided the possibility of a right-side cerebral lesion could not be overlooked. The Roentgen-ray studies showing a normal pituitary fossa, as well as the normal visual fields, eliminated this region as the seat of the tumor.

Operation (Dr. Grant).—Before exposing the cerebellar fossa, a ventricular estimation was done, both lateral ventricles being found equally enlarged. The posterior fossa was then exposed and a midline tumor involving the vermis and arising from the roof of the fourth ventricle was partially removed. The tumor extended laterally over the surface of the brain stem on each side. Only that part of the tumor could be removed which had occluded the aque-

duct. At the termination of the operation, fluid could be seen flowing down from above, showing that the cerebrospinal fluid circulation had been unblocked. Pathologic examination showed the tumor to be a medulloblastoma.

The child made an uneventful recovery. She received a course of deep *x*-ray therapy prior to her discharge from the hospital and two other similar treatments at intervals of six weeks. Since that time two other treatments, three months apart, have been given. When last seen in June, 1929 her condition was normal, no evidence of pressure could be determined by lumbar puncture or fundus examination. The suboccipital decompression was not tense.

DISCUSSION

The case represents well the clinical findings of midcerebellar tumor. The sudden onset of pressure symptoms which may show remissions, the later development of a rather vague and elusive cerebellar syndrome, the cracked-pot sound to percussion over the cranium, the absence of well marked nystagmus are all suggestive of a lesion of this region. When compared with the cerebellar symptoms produced by a tumor of the cerebellar lobes, the paucity of typical findings in vermis lesions is striking.

Symptoms.—The history these children give is so uniform as to have definite significance. At the onset the average age was eight years, the oldest fifteen, the youngest three years. There was little or no difference between the sexes. As these tumors develop in size they at once impede the cerebrospinal fluid circulation. As a result the earliest impressive symptoms are those of pressure—vomiting attacks with headache. These bouts of vomiting and headache are usually considered by the attending physician as due to gastro-intestinal disturbances and the child treated accordingly. Curiously enough the vomiting and headache come on intermittently as though the tumor blocked the flow, caused pressure symptoms, and then the fluid forced itself past the obstruction with relief of tension.

Since the cranial sutures in young children have not completely closed, as pressure develops compensatory separation occurs and the head enlarges and becomes box-like. And very fortunate it is that the sutures do separate as pressure develops, for otherwise many more of these children would be totally blind before the true nature of the condition is recognized. Enlargement of the head relieves pressure on the optic nerves to some

extent and prevents prompt and early visual loss. Furthermore, at this age visual loss does not mean much to the patient and as it develops gradually does not cause much complaint. Little by little the parents notice that the child is becoming clumsy, it falls more easily, and the gait is uncertain. Over a third of the cases in this series developed a diplopia which was often the first bit of evidence leading to the suspicion that the vomiting and headache might be due to an intracranial rather than a gastro-intestinal condition. Finally an examination of the eye-grounds is completed which reveals a choking of the disks, confirming the presence of intracranial pressure. Admission to the hospital usually follows. The average period for the development of symptoms prior to hospitalization was five months, the longest period ten months, the shortest a single month.

On first examination a very shrewd guess may be hazarded as to the position and nature of the lesion by anyone who has seen many of these cases. The enlarged head with the definite cracked-pot percussion note, the marked cerebellar gait with ataxia more pronounced in the trunk and legs than in the arms, the hypotonia and arreflexia, the suboccipital tenderness, and often slight retraction of the head in a child with a history of sudden onset of pressure symptoms presents an unmistakable clinical picture. But that the process of education in this matter was slow is evidenced by the fact that in 2 of the cases in this series a diagnosis of suprasellar lesion was made and an operation carried through to expose this region with disastrous results.

With regard to the cerebellar symptoms, it is the impression on the part of those who examined these children that the trunk and legs are definitely weaker and more ataxic than the arms. The extremities were usually equally involved. A unilateral predominance of cerebellar symptoms was unusual. A tendency to fall backward was particularly noted in six instances. Considering the position of the tumor in the midline involving the vermis, the fact that the ataxia was most marked in the trunk and legs would bear out the claims of recent investigators that this area of the cerebellum had a specific control over these regions. Nystagmus was noticeable by its absence in 10 of these

17 cases. That nystagmus may be absent in midline cerebellar lesions should be remembered, for it has always been considered almost a pathognomonic sign of cerebellar disease. The lack of this symptom went far toward clinching an incorrect diagnosis in one of the patients under consideration.

In 2 cases cerebellar fits were noted with retraction of the head and tonic spasms, with stiffness and rigidity of all extremities.

Diagnosis.—The accessory examinations, Bárány tests, *x*-ray, eye-ground, and perimetric tests gave no information of value. In fact the Bárány tests, done in seven patients, placed the lesion above the tentorium in four, reporting the cerebellum as negative. Fundoscopic studies merely confirmed the increased intracranial pressure by describing choked disks. The perimetric tests, when possible, simply showed concentric contraction of the fields. *x*-Ray studies revealed convolutional atrophy, separation of the sutures, and in 3 cases because of marked erosion of the sella, concluded that the tumor might be in this region. That posterior fossa lesions causing a block and dilatation of the third ventricle may thereby cause disappearance of the clinoid process, should always be kept in mind. Furthermore, pressure in this region by a dilated ventricle may produce evidence of pituitary dysfunction by pressure on the pituitary. This may make the differential diagnosis still more confusing. Ventriculography may help in arriving at a correct localization, although in 1 case in which it was attempted misinterpretation of the air shadows resulted in a supratentorial operation. If air is to be introduced it should certainly be done by ventricular tap and not by encephalography. From the position of these tumors medullary compression is a constant danger. Lumbar puncture even for pressure readings should be avoided. In a recent case lumbar puncture and a Bárány test were done within twenty-four hours. The child suffered from a medullary collapse and an emergency suboccipital craniectomy was necessary to save its life.

The diagnosis is made on the history, the abruptness of onset, the high choked disk, and the cerebellar symptoms, although they may be vague and nystagmus may be absent.

Furthermore, we know that cerebellar tumors are more common than suprasellar lesions in children.

Treatment.—Once the diagnosis is made the treatment is, in our opinion, surgical. To be sure, *x*-ray therapy is quite effective in controlling the growth of these medulloblastomas—in 1 case the tumor was held in check for two years by this treatment alone. But in another instance medullary collapse and subsequent death followed deep roentgenization without operation. Furthermore, while medulloblastomas are the common tumor type in this region, solid astrocytomas are quite frequently encountered here. These tumors do not respond favorably to *x*-ray. Valuable time may be lost in treatment and the child so weakened and so much vision sacrificed by the continuous intracranial pressure that subsequent operation will not be effective. Operation, relief of pressure, verification of the lesion, and then institution of *x*-ray treatment if the tumor is radiosensitive is the proper sequence of treatment.

The picture revealed by the cerebellar exposure is typical. The vermis of the cerebellum is widened, the cerebellar tonsils may be found forced down through the foramen magnum. If the vermis is widened but no tumor can be seen on its surface or below between the tonsils, the vermis should be incised longitudinally to expose the surface of the growth. Often the tumor presents itself between the cerebellar lobes at the foraminal rim and extends down in a tongue-like projection over the upper cervical segments of the cord. At times the tumor makes its appearance on the surface of the vermis and seems to be spreading through the subarachnoid space over the cerebellar lobes. That these neoplasms are highly malignant and may readily infect the meninges has long been recognized (Fig. 420). In one of our series of children a spinal metastasis has been verified pathologically. In another spinal cord symptoms have already appeared. The presence of a spinal block has been proved by injection of campiodol and the Queckenstedt test. In one of the few adults harboring a cerebellar medulloblastoma, a spinal metastasis was revealed by laminectomy.

The chief aim of the surgeon is to remove as much of the

tumor as possible, but above all to unblock the aqueduct. While it may seem possible to brush the cerebellum away from the tumor without much difficulty on the surface, in the depths the line of separation is soon lost. But by careful manipulation from below upward, it is often fairly easy to expose the roof of the fourth ventricle and tease away that part of the growth which lies directly in the aqueduct. This has been possible in 4 of the last 5 cases attacked. That the obstruction in the aqueduct is relieved is shown by the free escape of cerebrospinal fluid downward from this region. Once fluid is obtained the operator can safely stop further manipulation if the patient's

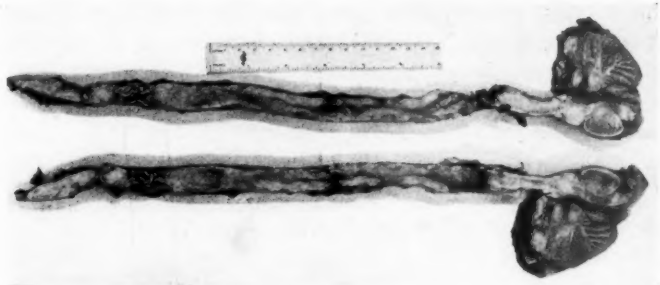

Fig. 420.—Necropsy specimen showing position of tumor of medulloblastoma type in midline. Note the involvement throughout the entire length of the spinal cord showing the tendency of these tumors to travel along the meninges and spread rapidly to other areas.

condition is poor. But simply to remove the surface of the tumor without getting away that part which dams back the cerebrospinal fluid circulation is only to make a bad matter worse. The edema subsequent to the operative trauma may result in a complete block with desperate consequences. Now that we know where to look for these tumors and how to attack them, and since we find the Bovie electrosurgical unit an excellent method of extirpation without producing hemorrhage, our operative results should improve.

Following operative removal, *x*-ray treatment is always indicated. It seems unquestionably to hold recurrence in check.

It is to be hoped that the recent cases alive after more thorough extirpation will enjoy a longer postoperative period free from recurrences.

Midline cerebellar tumors in children are commonly medulloblastomas. They produce abrupt symptoms of increasing pressure followed by cerebellar symptoms bilateral in character affecting the lower extremities and trunk more than the arms. Nystagmus may not be noted. While these tumors seem highly malignant and are placed in a position requiring very delicate manipulation for their removal, nevertheless, the treatment should be surgical. While they are radiosensitive, this therapy should be reserved as after-treatment to surgery. Decompression plus removal of enough tumor to unblock the fluid circulation and then roentgenization to control recurrence is the best line of attack at present available.

CLINIC OF DRS. JOHN SPEESE AND F. A. BOTHE

PRESBYTERIAN HOSPITAL

PERFORATION OF THE ILEUM BY A FOREIGN BODY WITH ABSCESS FORMATION

THIS patient was operated upon March 17, 1927, for a benign obstructive tumor of the cecum, at which time the terminal ileum, cecum, and ascending colon were resected and a lateral anastomosis performed between the ileum and the transverse colon. The case was reported in detail in THE SURGICAL CLINICS OF NORTH AMERICA, August, 1928, and was considered of interest because the diagnosis at operation was that of a malignant tumor, probably sarcoma, whereas the microscopic examination did not disclose any indication of a malignant formation.

The patient was perfectly well for two years after the operation when he developed dysuria and in a few hours was seized with severe generalized abdominal pain accompanied by nausea and vomiting. Marked frequency of urination accompanied the dysuria and voiding seemed to aggravate the symptoms.

When admitted to the hospital the abdomen was rigid, and there was generalized superficial tenderness most pronounced over the area of the bladder, and marked tenderness over the right kidney posteriorly. Urine analysis: Specific gravity 1.020, reaction alkaline, a trace of albumin, and microscopically 200 white blood-cells to the high power field and many epithelial cells. The hemoglobin was 88 per cent.; red blood-cells 4,080,000; white blood-cells 13,800; temperature 99.3° F.; pulse 88. A tentative diagnosis of acute pyelitis was made because of the tenderness over the right kidney, the presence of pyuria, dysuria, polyuria, and the fact that the abdominal pain and tenderness were mots pronounced over the bladder. Under expectant treatment the nausea and vomiting disappeared in twenty-four hours and in forty-eight hours the abdominal pain had subsided, the abdomen was soft, and there was no tenderness found on palpation. A study of the gastro-intestinal tract by *x*-ray was made and the only positive finding was a small amount of retention in the cecum at the end of twenty-four hours, the transverse and descending colon were empty. The *x*-ray diagnosis suggested adhesions in the terminal

ileum. While the previous operation and the *x*-ray findings indicated the possibility of partial intestinal obstruction, the history and the clinical findings were more suggestive of pyelitis than obstruction. This diagnosis was apparently substantiated by the rapid clinical improvement after simple eliminative measures were instituted. The patient was discharged five days after admission relieved of all symptoms except dysuria, which was still present to a slight degree.

Four weeks later he was readmitted to the hospital with a recurrence of severe abdominal pain which had existed intermittently for five days prior to admission. The pain was localized to the right lower quadrant of the abdomen and radiated down the right leg and into the genitalia. Considerable pain was experienced at the end of urination. Constipation occurred early in this attack, and was followed by profuse diarrhea. The patient had lost 10 pounds in weight in the past two months. A history was obtained of an acute specific urethritis prior to the previous admission, although this was denied when the patient was questioned at that time. The temperature was 99° F.; pulse 100; leukocytes 13,500; blood-urea nitrogen 20; blood chlorids 429, and the plasma CO_2 was 56 volumes per cent. The urine analysis was negative. There was generalized abdominal tenderness and rigidity, most pronounced in the right lower quadrant at the lower end of the scar of the previous operation.

Several days after admission, a mass the size of a small orange became apparent and an exploratory operation was performed through the lower right rectus, medial to the scar of the previous operation. Upon opening the peritoneal cavity there was no free fluid, but a mass was found in the ileocecal region which appeared to be of an inflammatory nature. The general peritoneal cavity was walled off with gauze and the mass explored. It proved to be an abscess containing very foul-smelling green pus, which on culture showed Streptococcus hemolyticus. The terminal ileum at the site of anastomosis formed the wall of the abscess and a hard sharp pointed object was felt protruding from the ileum and extending into the abscess. The foreign body was removed and was found to be a triangular shaped chicken bone about 3 cm. long and 1 cm. wide at its base, the shape prevented its escape from the intestine. The opening was closed and reinforced by a piece of omentum sutured over the area in the bowel wall from which the foreign body was removed, and the wound was closed with drainage. A fecal fistula developed five days after the operation, and drainage was profuse for six days. Subsequently the wound drained a very small amount of yellowish serous material intermittently. Two months after the operation the wound was entirely healed and there has been no further drainage.

At the present time the patient has no gastro-intestinal symptoms, no abdominal pain, his bowels are moving regularly, his appetite is excellent, and he has gained in weight. The local findings at operation serve to corroborate the diagnosis of a benign tumor made two years previously and the case is of further interest because of the rather uncommon complication of perforation occurring at the site of intestinal anastomosis.

INFECTED POPLITEAL ANEURYSM

THERE is no doubt that the conservative operation for aneurysm advocated by Matas is the ideal procedure to be adopted for aneurysms which are susceptible to surgical treatment. At times, however, conditions exist which render it impossible to perform the Matas operation, and a procedure or combination of procedures which is best adapted to the case at hand must be used. The following case occurring in a syphilitic is an instance of a ruptured aneurysm which had become infected and in which portions of the sac wall had undergone necrotic changes.

The patient, a man aged fifty-four years, was admitted to the Presbyterian Hospital December 20, 1928, with the chief complaint of swelling under his left knee. Three weeks before admission a small swelling which has gradually increased in size was noted. As the swelling enlarged, walking and bending the knee became more difficult and the patient was incapacitated and confined to bed two weeks before admission to the hospital. He denied having had a chancre.

Physical examination revealed a poorly nourished elderly negro. There were many carious teeth, the tonsils were small and cryptic, the heart was enlarged to the left, and a systolic murmur was heard over both the mitral and aortic areas, but there was no evidence of decompensation. The patellar reflexes were diminished, the pupils were equal, but reacted very poorly to light and accommodation. There was a firm swelling about the size of a lemon in the popliteal space. A faint pulsation was palpable and a distinct systolic bruit was audible over the mass. The skin in the popliteal space showed no changes from the normal. The pulsations of the dorsalis pedis and posterior tibial arteries were barely palpable. The blood-pressure was 126/78; temperature 98.3° F.; hemoglobin 61 per cent.; red blood-cells 3,290,000; white cells 9700; blood Wassermann +4. A diagnosis of popliteal aneurysm was made.

The patient was kept in bed and large doses of iodid were administered. Four days after admission he developed a slight fever associated with a cough, which subsided, and in a few days the temperature returned to normal. Fourteen days after admission there was a recurrence of fever which was higher and of a septic type. The popliteal mass at this time was firm, not so circumscribed as on admission, due to induration in the surrounding tissues, which, however, did not show fluctuation or increase in local temperature. Infection of the aneurysm or the surrounding parts was suspected as no other cause for the septic type of fever could be found.

Aspiration of the superficial portion of the mass was performed under local anesthesia and pus was obtained. With a tourniquet in place and ready to be applied, a small incision was made in the midline over the mass in the popliteal space. As the incision was extended beneath the skin and subcutaneous fascia, an infected laminated clot protruded and was followed by profuse hemorrhage. The tourniquet was applied and a second incision was made above in a sterile field and the femoral artery ligated in Hunter's canal. The orifices of vessels communicating with the sac were sutured and the tourniquet was loosened. Profuse hemorrhage occurred from the distal orifice showing that good collateral circulation existed. This orifice was then sutured over and the bleeding controlled. The greater part of the remaining sac wall was so friable from necrosis and infection that no attempt at plication was made. A culture of the aspirated pus showed Staphylococcus albus. After the operation no pulsation of the dorsalis pedis or the posterior tibial arteries could be palpated but the entire extremity was warmer. The foot and leg were wrapped in cotton, elevated and heat applied.

Twelve hours after the operation, pulsation of the dorsalis pedis and posterior tibial arteries was faintly perceptible. A marked febrile reaction occurred after the operation. The first four days the fever ranged between 102 and 103° F. On the fifth day the temperature settled down to 100° F., and gradually decreased, returning to normal on the eleventh day. Drainage from the wound was seropurulent in character but gradually decreased until the wound was entirely closed. A daily blood-culture was taken on four consecutive days after the operation and they were all negative. A partial toe-drop was observed twelve days after the operation, a posterior molded plaster-of-Paris splint was applied to the foot and leg, and baking and massage were given to correct this deformity. Under this therapy motion of the foot and the toe-drop improved. The patient was discharged from the hospital six weeks after the operation, able to walk but the toe-drop had not entirely disappeared. The pain in the extremity was relieved and the wounds were completely healed. The patient failed to report for further treatment, but when last seen, six months after the operation, there was no apparent disability.

Partial disintegration of clots may occur in aneurysm, rarely, however, are they infected as in this case. It seemed likely that staphylococci entered the general circulation during the operation, for the patient developed a typical septic type of fever for several days afterward. However, the postoperative course and negative blood-cultures made it apparent that the fever was due to the local infection and not to septicemia.

The proximial portion of the vessel was ligated in Hunter's canal well above the proximal orifice because of the presence of infection and the necrotic condition of the sac wall. This required a second incision which was considered safer in order to

prevent septicemia as well as a guard against the development of secondary hemorrhage. These precautions could not be observed in the distal part of the vessel, however, as it was necessary to oversew the artery directly at its orifice into the sac in order to preserve the collateral circulation. The paralysis of the peroneal nerve was most likely traumatic in origin as it did not appear until the twelfth postoperative day, and there was a definite improvement in the function of the affected parts at the time the patient was discharged from the hospital, six weeks after the operation.

ILEOCECAL OBSTRUCTION

MODERATE or severe degrees of ileocecal obstruction are not uncommonly associated with inflammatory lesions of the appendix. This is particularly true in the chronic forms of the disease, but is occasionally found in the acute lesions. Our interest in this condition has been aroused as relief of symptoms was not obtained in certain patients operated upon for chronic appendicitis. In these cases we found that the terminal ileum was thickened, and either the opening into the cecum was not easily demonstrable because of adhesions existing between the ileum and cecum, or, the terminal ileum was bound down by adhesions, kinking it and interfering with the motility of this portion of the bowel. The large number of patients in whom such pathologic conditions were found has led us in the past three years to make a routine examination of the cecum and terminal ileum whenever possible.

While the actual cause of the condition is difficult to explain in all instances, most of the cases encountered were confined to two groups: first, patients suffering from chonic appendicitis; second, patients having a continuation of symptoms, although the appendix had been removed at a previous operation.

The effect of long-standing irritation occurring in chronic appendicitis probably produces the changes leading on to obstruction in most instances, although in some patients a history of appendicitis is lacking.

Apart from attacks of appendicitis, constipation and flatulency were the most constant and characteristic symptoms. While the degree of constipation varied with but few exceptions, all patients had to take cathartics. Apparently the narrowing of the ileocecal opening, preventing the contents of the bowel from gaining ready access to the cecum, has been responsible for the flatulency and more or less for the development of constipation. Toxic symptoms, particularly headaches, were noted

when constipation was of long duration. As similar symptoms occur in cases of visceroptosis with a low-lying mobile cecum, at times the differential diagnosis from this condition is most difficult.

In many cases a gastro-intestinal study by *x*-ray may reveal the ileocecal narrowing and partial obstruction, but this finding is not constant and an exact diagnosis is not always possible by this means. In this event it has been our practice to recommend exploratory operation after a reasonable trial has been given to dietary and other measures carried out by the internist.

When the ileocecal region is inspected in many of these cases, a normal appearance of the serosa seems apparent. If an attempt is made to introduce a finger through the valve, by invaginating the ileum, the opening is found narrowed and at times, because of adhesions and thickening of the ileum, the opening cannot be demonstrated. If careful dissection is made, the ileum can be released from the cecum and gradually the opening will become more and more apparent and the finger readily passed into the cecum by invaginating the ileum. One-half to 2 cm. of the bowel may be separated by this means before a sufficient degree of patency is apparent. Other adhesions or bands should, of course, receive appropriate treatment.

After freeing adhesions and particularly the ileocecal variety, the resulting defect in the serosa is covered by a free omental graft. A thin and well vascularized portion of the greater omentum is used, as this is the most saisfactory type of graft. The transplant is carefully sutured over the serosa defect, multiple sutures are used to obtain good approximation as adhesions to the edge of the graft occur less frequently when this precaution is observed. The raw edge of the greater omentum from which the graft is severed is buried within the two layers of the omentum in order to prevent it from becoming adherent to some portion of the abdominal viscera.

The following case histories are abstracted briefly in order to illustrate the types of pathologic lesions encountered, the symptoms they produced, and the means employed to correct the conditions.

Case I.—V. A., male, forty-three years of age, was admitted to the Presbyterian Hospital with the chief complaint of pain in the abdomen. For the past two years the patient has suffered from flatulency, for which frequent cathartics were taken. Following the catharsis he experienced attacks of pain in the lower quadrant of the abdomen. For the first few months of his illness the pain was nothing more than a dull ache and lasted approximately twenty-four hours. Subsequently the attacks increased in frequency, length of duration, and the pain was more severe. The last attack, a week ago, lasted four days and the pain was very sharp and intermittent. Appetite has been very poor because of the tendency to gas formation and constipation. He has had many dull headaches during the past two years which have also increased in frequency and severity. Upon physical examination the abdomen was slightly distended and there was moderate tenderness, but no rigidity over McBurney's point. The blood-count showed hemoglobin 103, red blood-cells 5,500,000; white blood-cells 7100. Urine analysis negative, and a fractional gastric analysis showed a normal curve. An exploratory operation performed through a lower right rectus incision disclosed an obliterated appendix which was moderately inflamed. On examining the ileocecal junction the terminal ileum was found to be adherent to the cecum and fixed by dense adhesions. The valve would not admit the tip of the little finger. The adhesions were dissected at the ileocecal junction and $1\frac{1}{2}$ cm. of the terminal ileum released. Following the liberation of these adhesions the valve could be entered easily with the index-finger. The resulting serosal defect was covered with a free omental transplant, employing the procedure described above. The patient made an uneventful recovery and, nine months after operation, reports that the headaches have disappeared, constipation has been completely relieved, and the use of cathartics had been discontinued after being used continuously for many years. This case illustrates the most typical form of ileocecal obstruction accompanied by toxic symptoms as well as attacks of pain. The degree of obstruction found at the operation readily explained the cause of the attacks of intermittent sharp pains in the right lower quadrant of the abdomen following catharsis. We believe the ileocecal obstruction was the source of the patient's symptoms, and relief would not have been obtained by simple appendectomy.

Case II.—P. M., a male, fifty years of age, was admitted to the Presbyterian Hospital with a chief complaint of pain in the right lower quadrant, and constipation which had become more pronounced during the past two months. Six weeks before admission he developed a dull intermittent pain in the right lower quadrant of the abdomen which did not radiate and was not accompanied by nausea and vomiting. The attack lasted forty-eight hours and since that time he has suffered from a dull ache and considerable abdominal distention. Upon examination of the abdomen, no tenderness or rigidity were found and no masses were palpable. Hemoglobin was 93 per cent., red blood-cells, 4,560,000, and leukocytes 7800. A fractional gastric analysis showed an absence of free hydrochloric acid, the highest total acidity was 22. Urine analysis was negative. An exploratory operation was performed, and an inflamed appendix, which was kinked and doubled upon itself, was found in the

retrocecal space and removed. The ileocecal valve was found to be normal, however there was definite kinking of the ileum about 4 inches from its termination due to adhesions binding it down to the lateral wall. The adhesions were severed, the kink relieved, and the resulting serosal defect was covered with a free omental graft. The transverse colon was found to be adherent over the anterior surface of the ascending colon just above the cecum producing a definite angulation at the hepatic flexure. These adhesions were freed and the raw surfaces oversewn. The patient was discharged from the hospital fourteen days after operation, relieved of symptoms, his bowels have moved regularly, and there has been no recurrence of symptoms. The patient had a definite achlorhydria before the operation.

This second case is presented as an example of a disturbance of the motility of the terminal ileum, caused by adhesions binding this portion of the bowel to the lateral wall, there was no apparent obstruction in the ileocecal valve. The symptoms were similar to those in Case I with the exception that the patient did not suffer from headaches.

Case III.—D. M., a male, twenty years of age, admitted to the Presbyterian Hospital with the chief complaint of pain in the right lower quadrant of the abdomen. During the past year, the patient suffered from frequent attacks of dull pain in the right lower quadrant of the abdomen, which was accompanied by nausea, but no vomiting. Three days before admission, the patient developed moderately severe pain in the right lower quadrant, which gradually increased in severity, necessitating his going to bed. At the time of admission the pain had subsided, but there was still considerable tenderness. Appetite has always been good and the bowels have been regular. Upon physical examination there was slight tenderness and definite muscular rigidity over the right lower quadrant of the abdomen. Temperature and pulse were normal; there was no leukocytosis and the urine analysis was negative. Exploratory operation was performed and a chronically inflamed appendix was found, kinked and bound down by numerous adhesions. The ileocecal valve could be entered readily; the terminal ileum was bound down and kinked by adhesions. The adhesions in this case did not produce a marked angulation of the bowel, and after their liberation, a free omental graft was sutured over the raw surface. The patient made an uneventful recovery and was symptom-free when seen six months after the operation. In this instance, although there was no actual obstruction of the ileocecal valve, there was a definite disturbance in the motility of the distal portion of the ileum. The kinking was not so pronounced as that found in Case II and illustrates the slightest degree of angulation in which adhesions may be released. Adhesions are not divided in patients who are not suffering from constipation or toxic symptoms when there is only a slight degree of angulation of the bowel, as in these cases we feel that the motility of the bowel is not interfered with sufficiently to necessitate this procedure.

Case IV.—W. M., male, was admitted with a chief complaint of pain in the lower right quadrant of the abdomen. Twenty-four hours before admission he developed generalized abdominal pain which was followed by nausea and vomiting. Twelve hours later, the pain was localized in the right lower quadrant, became progressively worse, vomiting occurred three times before admission to the hospital. He had two similar attacks three years ago which lasted approximately forty-eight hours. Temperature was 98.2° F.; leukocyte count 10,200; urine analysis was negative. The abdomen was tender over the entire right side, and there was marked rigidity over the right lower quadrant. Operation was performed through a lower right rectus incision, and the appendix was found to be retrocecal and acutely inflamed. It was constricted about its middle with many old and new adhesions and was covered in places with a fibrinous exudate. Exploration of the ileocecal area showed many firm adhesions which constricted the ileocecal junction. The adhesions were liberated to overcome the obstruction and the resulting serosal defect was covered with a free omental transplant. The patient made an uneventful recovery, and when seen two years after operation, stated he had remained symptom-free, gained in weight, and his bowels were moving regularly. In this instance, adhesions produced the ileocecal obstruction and occurred in a case of acute appendicitis. When ileocecal obstruction was found complicating acute lesions, a history of previous attacks was usually obtained. The degree of ileocecal obstruction found would in all probability have been responsible for a continuation of this patient's symptoms, although the acutely inflamed appendix had been removed. In acute cases, we are confronted unfortunately at times with conditions which do not permit an exploration of the ileocecal valve and the terminal ileum.

Case V.—Mrs. E. S., twenty-five years of age, was admitted with a chief complaint of pain in the right lower quadrant of the abdomen and constipation. The patient has suffered from extreme constipation since thirteen years of age for which she has taken cathartics daily. In the last four years she has had numerous attacks of pain in the right lower quadrant of the abdomen which were not accompanied by nausea and vomiting. A diagnosis of chronic appendicitis was made in March, 1927, and the appendix removed. The symptoms were not relieved by this operation, in fact the constipation and attacks of pain became progressively worse. The abdomen was never distended, but severe headaches associated with drowsiness and fatigue had occurred frequently for two years. There was no tenderness or rigidity of the abdomen. The blood-count was normal and the urine analysis was negative. An exploratory operation was performed and the omentum was found to be adherent to the cecum at the site of the former operation. The omentum was liberated, the ileocecal junction examined, and adhesions were noted which partially occluded the ileocecal valve. They were freed and a fat transplant was sutured over the resulting peritoneal defect. The patient made an uneventful recovery and when seen one year after operation was relieved of the attacks of pain, constipation, and headaches, and had steadily gained weight since her second operation. This was a typical case with continuation of symptoms after the appendix had been removed and clearly demonstrates

the value of a careful exploration of the ileocecal region in cases of chronic appendicitis.

Case VI.—Girl, fifteen years of age, was admitted with a chief complaint of abdominal pain. Six weeks before admission the patient suffered from an attack of intermittent colicky pain in the right lower quadrant of the abdomen, which lasted forty-eight hours, and was accompanied by nausea, but no vomiting. Subsequently she had three similar attacks, the last one lasted for two weeks and the pain had just subsided at the time of her admission to the hospital. There was no history of constipation or headaches.

Upon abdominal examination marked tenderness and rigidity were found over McBurney's point. The temperature was 98.3° F.; the blood-count was normal, and the urine analysis negative. An exploratory operation was performed and a chronically inflamed appendix was found. There were a few small adhesions at the ileocecal junction, which slightly interfered with the normal patency of the valve. The adhesions were separated and the patency of the valve restored. An omental transplant was used to cover the peritoneal defect. The patient made an uneventful convalescence and has been symptom-free since the operation. This case illustrates the mild type of ileocecal obstruction in which the patient experiences slight attacks of pain unassociated with constipation or toxic symptoms.

CLINIC OF DR. CALVIN M. SMYTH, JR.

METHODIST AND ABINGTON MEMORIAL HOSPITALS

TRAUMATIC RUPTURE OF THE SPLEEN

IN 1924 Pfeiffer and the writer[1] reported a group of cases in which the spleen had been removed for traumatic subcutaneous rupture. At that time we called attention to the fact that while the spleen was not essential to life, and that its removal was not followed by symptoms which would contraindicate splenectomy for rupture, very little was known about the remote effects of removing the spleen from adolescents. The cases which we reported had been followed from two to four years and in every instance the patients exhibited a mild though definite anemia, a generalized adenopathy, and lassitude. As a result of these observations we recommended that vigorous and persistent treatment be directed to this anemia. Five years having elapsed since this report it would seem proper that the matter again be drawn to the attention of the profession.

Of the 4 cases reported, 3 are alive and well, 1 was killed in a railroad accident. In this report we present 5 more cases operated upon for the same condition, all of whom are alive and well after three to five years. In 4 of the 5 the spleen was removed; in 1, on account of the desperate condition of the patient, tamponade was done. In 2 more cases, both gunshot wounds, the spleen was removed with a fatal outcome; a case complicated by injury to the pancreas also died.

Case I.—J. M., age seventeen years, admitted to the Methodist Episcopal Hospital September 24, 1924, complaining of pain in the abdomen and left shoulder, and extreme weakness. Three days prior to admission, while playing football, he was tackled and struck forcibly in the abdomen by the knee of the tackler. He said that his "wind was knocked out." He was able to

walk to his home and ate supper. Following the meal he vomited. The following day he went to work, but had to leave about 10.30 A. M. on account of weakness. He went to bed and the family physician was called. He was given strychnia and liquid diet, but continued to grow progressively weaker and became very pale. The temperature and pulse remained normal, but he complained of increasing pain in the abdomen and left shoulder. On the afternoon of the fourth day the temperature fell to 96.4° F.; the pulse rose to 120, and he appeared very ill. He was seen with the family physician at 8 P. M. In addition to the above he had slight distention of the abdomen with great tenderness in the left upper quadrant and dulness in the left flank on percussion. A diagnosis of internal hemorrhage due to rupture of the spleen was made and he was immediately removed to the hospital.

A blood-count showed red blood-cells 2,600,000; white blood-cells 21,000; hemoglobin 51 per cent.

He was immediately prepared for operation and anesthetized with ether. Intravenous infusion with normal saline was begun with the incision. The abdomen was opened through an upper left rectus incision and the peritoneal cavity was found to be filled with clots and fluid blood. The spleen was quickly delivered and was found to be torn almost completely in two. A clamp was placed across the pedicle and a rapid splenectomy performed. The vessels were then ligated separately and the pedicle also secured by transfixion ligature. Seven hundred and fifty c.c. of blood was given by the citrate method and the abdomen closed in layers, a small strip of rubber dam being placed in the angles of the wound. Convalescence was somewhat stormy, but not at any time alarming and he was discharged on October 20, 1924. The various blood-counts made on this boy are shown in the table. He received injections of iron and arsenic for several months.

Exactly one year from the day of his operation the patient developed an acute intestinal obstruction for which he was operated upon by the writer. The obstruction was in the terminal ileum and presented no great difficulty in its relief. When the abdomen was opened a number of greenish bodies about the size of a split pea were noted studding the intestines. Having recently read Lee's[2] case reports in The Lancet, we considered the possibility of these being splenic implants and removed one for microscopic examination. This was later reported as splenic tissue. Convalescence was uneventful and he was discharged on October 12, 1925. As will be seen in the table, the anemia still persisted.

Nine months later it was necessary to operate again for intestinal obstruction. This time the obstruction was in the upper jejunum and the toxic reaction was very severe. The splenic implants were still visible. The patient again made a good recovery. Since that time he has developed two other similar attacks, in each instance preceded by dietary indiscretions and neglect of his bowels. In each instance he was removed to the hospital, but was relieved by gastric lavage, colonic irrigation, and intravenous injections of hypertonic saline. His general health has been good between these seizures, but he says that he never has any "pep." He works every day, but at night retires early and sleeps until he is awakened. If he keeps his bowels regulated by the daily use of mineral oil, taking an enema when-

ever the oil is not effectual, he feels quite well. If he neglects this he becomes nauseated and distended. He still has his anemia and there is still some degree of adenopathy.

Case II.—Frances A., age six years, admitted to the Methodist Episcopal Hospital on November 2, 1926. She had been struck by a motor truck about half an hour before. On admission she was not in profound shock, but was obviously badly hurt. The temperature, pulse, and respirations were 97, 130, and 35 respectively. She complained of pain in the entire abdomen and in the left shoulder. Examination revealed generalized rigidity, but the tenderness was more marked in the left upper quadrant. A blood-count showed hemoglobin 60 per cent.; erythrocytes 3,100,000; leukocytes 22,000; in other words, the typical blood-picture of hemorrhage. A catheterized specimen of urine failed to draw any blood. A preoperative diagnosis of rupture of the spleen was made and the patient immediately operated upon. Intravenous infusion of normal saline was begun with the incision. Under ether anesthesia the abdomen was opened through a left upper rectus incision. The peritoneal cavity contained many blood-clots and considerable free blood. The spleen was examined and the finger at once entered a deep, irregular laceration on the inferior surface; after delivery it was found that the laceration extended into the hilus and that a large artery had been injured in addition to the tear in the splenic pulp. A clamp was placed across the pedicle and after a rapid exploration failed to disclose injury to any other viscus, splenectomy was made in the usual manner. The abdomen was closed without drainage. The pulse at the conclusion of the operation was 140, and of only fair volume; no donor being available for transfusion, 350 c.c. of 10 per cent. glucose was given through the cannula still in place in the vein.

The postoperative course of this child was entirely uneventful. Frequent blood-counts were made during her stay in the hospital (see Table). A point of interest in this case was that the pain in the left shoulder persisted some days after operation and an *x*-ray examination revealed a hitherto unsuspected fracture of the surgical neck of the humerus. The diagnostic significance of the shoulder pain in this case was, therefore, invalidated.

Approximately three years after splenectomy this child, now aged nine, shows very little difference from other children of her age. She has grown normally, and according to the standard tables is only 1 pound under weight. She has made satisfactory progress in school, and exhibits no lassitude or increased desire to sleep. She has had no intercurrent infections. Her mother states that her only complaint is distention after eating. There is no adenopathy and no clinical evidence of anemia. A blood-count made on July 13, 1929 showed hemoglobin 79 per cent.; red blood-cells 4,620,000; white blood-cells 8500. The differential count shows the usual relative increase in lymphocytes.

Case III.—Lawrence V., age thirteen years, admitted to the Methodist Episcopal Hospital April 6, 1923 at 11 P. M. At 4 o'clock on the afternoon while riding a bicycle along the edge of a railroad platform he fell and struck his left chest on one of the track rails. In putting out his left hand to break

the fall he forcibly extended the wrist. He complained at once of great pain in the chest and wrist, but was able with the assistance of a companion to walk five city blocks to the hospital. In the accident ward he was examined by a resident physician who diagnosed a Colles fracture, and fracture of two ribs on the left side. The wrist was dressed on a Bond splint, the chest strapped, and the boy instructed to return to the surgical dispensary on the following morning. He walked home but did not feel very well, and while eating his evening meal he fainted. On regaining consciousness he vomited and complained for the first time of pain in the abdomen. He was brought to the hospital in a taxicab. The temperature, pulse, and respirations were 96.6, 110, and 24 respectively. The abdomen was rigid throughout and exquisitely tender in both upper and lower quadrants on the left. Over the lower left chest and upper left abdomen the percussion note was dull. This dulness fluctuated with change of position. A blood-count showed hemoglobin 65 per cent.; red blood-cells 3,120,000; white blood-cells 19,000. A catheterized specimen of urine was negative for blood. A diagnosis of ruptured spleen was made and the patient prepared for operation.

Under ether anesthesia the abdomen was opened through a left upper rectus incision and upon entering the peritoneal cavity there was a tremendous gush of blood. With the escape of the blood the patient went into collapse; the pulse became almost imperceptible, the respirations slow and shallow, and the color, chalk-like. Intravenous infusion which had not been started earlier through some misunderstanding was instituted, 20 minims of adrenalin given into another vein, and an immediate improvement was noticed. The bleeding was then located as coming from a laceration of the lower border of the spleen and the organ itself was seen to be unusually large and to have dense perisplenic adhesions. In such a situation a quick retreat was considered in order and a large gauze pack was introduced into the laceration and the abdomen rapidly closed; a medium-sized cigarette-drain being placed in the lower angle of the wound. He was returned to the ward in fair condition and reacted well on the usual postoperative routine including hypodermoclysis twice daily for three days.

The convalescence was stormy in many ways. Vomiting was unusually persistent and symptoms of paralytic obstruction appeared on the fifth day. These were satisfactorily overcome by a course of eserin and strychnia, hot fomentations to the abdomen, and gastric lavage. No attempt was made to remove the pack until the ninth day when it had become saturated with the wound secretions; the removal was made under nitrous oxid anesthesia, and no secondary bleeding occurred. Another large cigarette-drain was placed down to the spleen. From this point he did well, and no infection of moment developed. The drains were removed on the fifth day after the pack and on the fourteenth day after the operation. The wound was thereafter irrigated daily with 1 : 3000 potassium permanganate and allowed to heal by granulation. The patient was discharged on the thirty-second day after operation.

In April, 1927 this boy was again admitted following an automobile accident in which he had been thrown out of a car striking his abdomen on a fence rail. He complained of great pain and had difficulty in breathing, but exhibited no signs of either hemorrhage or shock. Examination was prac-

tically negative, but he had a large incisional hernia through the lower part of his scar. He had never returned for follow-up examination and had done nothing about it, although he had been repeatedly advised by others to do so. At the end of three days he felt perfectly well, but stated that he had had a good deal of indigestion and constipation since his operation and that on one occasion he had had severe pain in the right lower abdomen associated with fever and vomiting.

He was strongly advised to stay in the hospital and have his hernia repaired and his appendix removed. He finally consented to do so. The scar of the old operation was excised and the layers of the abdominal wall separated as far as possible. The appendix was subacutely inflamed and was removed. Satisfactory examination of the spleen could not be made on account of dense adhesions, but a careful search failed to reveal any splenic implantations on the intestine. It was possible to close the peritoneum with interrupted sutures, but the defect in the fascia was too great to be overcome without great tension. The repair of the hernia was completed with living sutures of fascia lata after the technic of Gallie. The patient made an entirely uneventful convalescence. This boy's general health has in no way been impaired by the injury to his spleen. He is working every day at a more or less laborious occupation.

Case IV.—Kent F., age twenty-four years, Seaman U. S. Navy, admitted to the Methodist Episcopal Hospital November 26, 1926. Fifteen minutes before admission he had been stabbed in the abdomen by a bar-tender, when in the line of duty he had attempted to remove two drunken sailors from a saloon. He was brought to the hospital in a taxicab. Examination revealed a stab wound 3 inches long in the epigastrium with omentum protruding from it. The wound was bleeding profusely. There was no shock; the temperature, pulse, and respirations were 98, 98, and 24. He was in extreme pain.

He was operated upon immediately under ether anesthesia. The stab wound was enlarged upward and downward and a rapid examination of the abdomen made. Bleeding continued very freely. The stomach was not injured, but seven perforations of the small intestines were found. These were closed by purse-string sutures of chromic catgut and reinforced with Lembert sutures of linen. Blood continued to well into the wound from the left side of the abdomen. After packing off it was found that the splenic pedicle had been almost completely severed and splenectomy was necessary in order to prevent subsequent gangrene—the blood-supply having been completely destroyed. In order to facilitate the removal a transverse incision was made through the left rectus. The abdomen was closed without drainage. The patient left the table in good condition and for four days had an uneventful time. On the fifth day he developed obstructive symptoms which proved to be paralytic in nature, and due to a "peritonitis externa." The wound broke down to the peritoneum, but the viscera were not exposed. The obstructive symptoms were relieved by continuous drainage of the stomach with the Jutte tube, and fluids were supplied by continuous intravenous drip after the method described by Matas and which we have employed in such cases many times with great satisfaction. The wound was Dakinized. A blood transfusion of

750 c.c. was made on the sixth postoperative day, and from that time convalescence proceeded in an orderly manner, the patient being removed to the Naval Hospital on the twenty-eighth day.

Following his discharge from the Naval Hospital this man was returned to active duty on May 13, 1927. He was stationed at the Naval Prison at Paris Island and was able to perform all of his duties. His record shows that he was discharged from the service on May 15, 1928; his physical condition at that time being given as "good." This case is of special interest as it is the only one of our cases in which the normal spleen was removed from an adult.

Case V.—Steve M., age six years, admitted to the Abington Memorial Hospital December 8, 1924 at 3.00 P. M. Immediately before admission he had been struck and knocked down by an automobile; the front fender struck him in the abdomen. On admission the temperature, pulse, and respirations were normal. He complained of pain in the abdomen, nausea, and vomiting. Examination showed a definite contusion on the left side of the abdomen just below the costal margin. The resident physician thinking that he was dealing with an ordinary case of abdominal contusion did not report the case until 7.30 (something over four hours) when the patient after vomiting twice complained of increasing pain and began to look very pale. A blood-count showed hemoglobin 80 per cent.; red blood-cells 4,500,000; white blood-cells 22,000. The urine did not contain blood. The abdomen was rigid throughout, very tender in the left upper quadrant, and percussion showed movable dulness in the left side of the abdomen. A diagnosis of ruptured spleen was made. The patient was anesthetized with ether, intravenous infusion with salt solution started, and the abdomen opened through a left upper rectus incision. The spleen revealed a ragged tear in the inferior surface involving the entire diameter and about two-thirds of the thickness of the organ. Splenectomy was made in the usual manner and the abdomen closed without drainage. Convalescence was uneventful except for an attack of tonsillitis in the second week. He was discharged from the hospital on January 13th, the thirty-sixth postoperative day.

Follow-up.—At present, nearly five years after splenectomy, this boy is in perfect health. He has not shown lassitude or decreased resistance to infection, and has grown normally. The blood-count made one year ago shows no anemia, but the relative lymphocytosis remains.

DISCUSSION

In view of the observation of this group of cases, certain conclusions may be properly drawn.

Diagnosis.—Rupture of the spleen in many instances gives rise to symptoms which are mild and out of all proportion to the severity of the condition. Shock, in our experience, has more often been absent than otherwise. The symptoms of hemorrhage have, on the other hand, been present early, but show a slow

progression. There is always a high leukocytosis long before any diminution of the red cells and hemoglobin occurs. This, of course, is characteristic of internal hemorrhage in general and not limited to hemorrhage due to splenic injury. Vomiting is almost invariably a feature, and pain referred to the left shoulder is frequently observed. Tenderness in the left upper quadrant was present in every case and a certain amount of rigidity could always be elicited. Dulness either fixed or movable was observed in most of our cases. One should not be led to temporizing on account of the history which is frequently misleading in that the injury received would not appear serious enough to produce rupture of a viscus. On account of the absence of shock and the slowly progressing symptoms of hemorrhage, many cases have been temporized to death. As in all other intra-abdominal injuries an exploratory incision is indicated in the doubtful case.

Choice of Operation.—In the matter of operation we are committed to splenectomy wherever possible. The results in patients observed over long periods have served to strengthen the conclusion which we drew in 1924, namely, that "there is no evidence of such adverse influence on health or longevity as to contraindicate splenectomy for traumatic rupture which is ordinarily the operation of choice." Strauss and Tumpeer[3] make this statement verbatim in a recent article on this subject, although no reference is made to our previous report. We have had no experience with splenorrhaphy as it seems that the obvious disadvantages of the procedures far outweigh its possible value. In the 1 case treated by tamponade the result was very satisfactory. We have employed tamponade in 2 other cases of rupture of the liver without secondary hemorrhage or troublesome infection taking place. We regard it as a valuable procedure and one which should always be considered in the case obviously unfit for the more formidable operation of splenectomy. Regarding technic, all but one of our operations were done through a left rectus incision. The one opened in the midline, because of the pre-existing stab, was the only instance where it was necessary to add a transverse incision. We have never practised auto-

transfusion. Postoperative transfusion of suitable blood is of unquestioned value. The administration of normal saline by vein with the commencement of the operation is, we believe, of value in preventing immediate shock. This should not be given earlier on account of the danger of increasing bleeding. Drainage is, as a rule, unnecessary.

Postoperative Reactions.—In every one of our cases a rather sharp febrile reaction appeared sometime during the first seventy-two hours. This was associated with a sharp rise in the total leukocyte count and a marked increase in the relative number of lymphocytes. Obstructive symptoms frequently appear, but are practically always paralytic and not mechanical in origin.

TABLE OF BLOOD-COUNT RESULTS

Case.	Time in relation to operation.	H. B. Per cent.	R. B. C.	W. B. C.	Differential.					
					P.	S.L.	L.L.	T.	E.	B.
I.	Preoperative.	51	2,600,000	21,000						
	72 Hours.	65	2,400,000	31,000	40	55	2	2	1	0
	2 Months.	82	4,600,000	8,600	33	55	10	1	1	0
	15 Months.	82	4,350,000	8,700	43	49	8	1	1	0
	2 Years.	80	4,320,000	6,950	35	55	7	3	1	0
	5 Years.	87	3,900,000	10,200	42	51	6	1	0	0
II.	Preoperative.	60	3,100,000	22,000						
	1 Week.	63	3,600,000	15,200	48	35	6	1	8	1
	2 Years, 8 months.	79	4,300,000	8,500	51	42	4	2	1	0
III.	Preoperative.	60	3,120,000	19,000						
	4 Years.	92	4,600,000	9,700	71	20	6	1	1	1
IV.	92 Hours.	64	3,390,000	11,450	69	25	1	1	4	0
	10 Days.	71	3,500,000	16,000	56	37	6	0	1	0
V.	Preoperative.	80	4,500,000	22,000						
	24 Hours.	60	3,450,000	12,000	88	12	0	0	0	0
	1 Week.	60	3,100,000	23,000	43	53	1	2	1	0
	1 Month.	63	3,450,000	9,300	60	36	2	0	1	0
	2 Years.	80	4,300,000	9,000	62	33	4	1	0	0
	4 Years.	89	4,800,000	8,600	60	34	2	2	1	1

Prognosis.—The immediate prognosis is good provided that delay in operating is avoided. None of our cases of subcutaneous rupture have died. Where the situation is complicated by concomitant injury to the pancreas, liver, or a hollow viscus, the prognosis naturally becomes graver. As to the remote prognosis, our experience has been that prolonged observation and treatment of even a mild degree of anemia is necessary and worthwhile. The anemia often responds to treatment, but re-

curs with its cessation. In no case has the blood-picture returned completely to normal; this is especially true of the differential count. However, it would seem reasonable to regard the persistent increase of these elements as a compensatory affair.

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CLINIC OF DR. HENRY P. BROWN

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DIAPHRAGMATIC HERNIA

THE case we wish to discuss, a hernia of the diaphragm, while not being unusual, is certainly not a condition frequently encountered. In reviewing the records at the Pennsylvania Hospital from 1910 to 1929, 1 case was recorded; at the Presbyterian Hospital from 1918 to 1929, 1; and the present instance is the only recorded one at the Children's Hospital since 1920.

In 1926, Eillen G., a white girl of two years, was admitted as a feeding case to the service of Dr. Alfred Hand, at the Children's Hospital. At that time it was discovered that she had a hernia of the diaphragm and a barium enema showed that her entire colon, above the splenic flexure, was in the left chest. The child was not in very good condition, and the surgeon who saw her in consultation thought that operation should be deferred. Since then she has been under Dr. Hand's observation.

She was readmitted in April, 1929, with the history that for the two weeks preceding she had been having attacks of abdominal pain and vomiting after every meal, becoming more severe in character, and it was thought that intestinal obstruction was developing.

Examination showed that she was a healthy-appearing, normally developed child of five, apparently not suffering except during attacks of colicky pain which were referred to the left hypochondrium. The right chest was normal to auscultation and percussion, while the left side showed tympany, absence of breath sounds, and intestinal peristalsis could be easily heard. The heart was displaced about 3 cm., and its sounds were good. The abdomen was scaphoid; rectal examination was negative and a bismuth enema revealed that the entire colon, above the splenic flexure, was still in the chest, extending to the upper limit of the pleural cavity.

It was thought inadvisable to make a complete bismuth gastro-intestinal study on account of the symptoms of intestinal obstruction, and operative intervention seemed indicated for the same reason.

The question arose as to the most advisable approach to the hernia, whether through the chest or by way of the abdomen, and it was decided to adopt the latter, subsequently opening the chest if the hernia could not be reduced from below.

Under nitrous-oxid, oxygen-ether anesthesia, the abdomen was opened through a left paramedian incision, extending, as advocated by Dr. Arthur D. Bevan, from the xiphoid half way to the umbilicus and then carried outward through the rectus muscle. The flap of the upper left abdominal quadrant thus exposed was reflected upward and outward, giving an excellent exposure—one of the most important factors in dealing with hernia of the diaphragm.

Exploration revealed that the greater part of the fundus of the stomach, all of the small intestine beyond the duodenum, all of the large bowel above the splenic flexure and the spleen had entered the left pleural cavity through an

Fig. 421.—*x*-Ray following barium enema, showing intestinal tract from terminal duodenum to splenic flexure of colon, contained within left thoracic cavity.

aperture in the diaphragm. This opening, apparently congenital in type, extended from the lower end of the esophagus, which was plainly visible, to the lateral chest wall and readily admitted four fingers of the examining hand. No adhesions could be felt within the chest and yet, due to the negative pressure exerted by the diaphragm during respiration, it was impossible to withdraw the intestines from the pleural cavity.

As has been suggested by Dr. Charles W. Mayo, a rubber tube was inserted into the chest through the opening in the diaphragm, the negative pressure being thus minimized, and with the greatest ease intestines, spleen,

and involved part of the stomach were withdrawn into the abdomen. As a matter of interest the tube was then removed and it was most interesting to observe how rapidly the intestine was redrawn into the pleural cavity.

After reinserting the tube and reducing the intestines, the aperture in the diaphragm was closed from esophagus to the chest wall, using interrupted catgut sutures followed by a continuous row of the same material to close the openings between the interrupted sutures, the tube being withdrawn as the last suture was tied. Considerable difficulty was experienced in closing the abdomen and undoubtedly its contents were under some increase of pressure when it had been completed.

We believe that in this particular case it would have been practically impossible to have replaced the intestines within the abdominal cavity had the approach to the hernia been through the chest instead of by way of the abdomen.

The operation was quite a severe one for the youngster and she succumbed ten hours later, apparently from cardiac failure, the respiration during the two hours preceding death being rapid and shallow.

Whether the failure of the heart was due to increased pressure exerted upon the diaphragm by the intestines, to the failure of the heart to accommodate itself to the altered condition in the left pleural cavity, or to the fact that the operative procedure was too much for the child, or to a combination of the above factors, we do not know.

It was not determined after operation whether the intrathoracic pressure on the left side was increased or diminished, an exploring needle unfortunately not having been introduced to determine this point. In view of the fact that the child showed no respiratory embarrassment neither during the operation nor for eight hours afterward we are disinclined to believe that the altered condition of pressure in the left chest was the deciding factor in the fatal outcome, and feel rather that she died a cardiac death. Permission for autopsy was unfortunately not obtained.

It is not our intention to discuss the etiology of diaphragmatic hernia, there being several excellent articles in the literature dealing with this phase of the subject, but we wish to mention one or two points of interest from a clinical viewpoint.

The first is, at what age should a child with a congenital hernia of the diaphragm be operated upon, symptoms of intestinal obstruction not being present? Should the latter complication occur, immediate relief would of course be indicated.

In view of the fact that the operation is rather a formidable one for a child, especially if a large portion of the intestinal tract is contained within the chest, possibly more or less fixed by adhesions; and also in view of the well-known observation that patients have lived comfortably for years with a considerable por-

tion of the intestinal tract within the pleural cavity, discovered only at postmortem, it is our opinion that operation should be deferred till the patient is better able to withstand what may prove to be a severe procedure. This is sometime after twelve or fourteen years of age, providing of course that the condition is not giving rise to untoward symptoms, and that he can be kept under observation.

One of the principal arguments against such delay is the possibility of suddenly developing intestinal obstruction which may greatly lessen the chances of a successful outcome of the enforced operation. A less serious one is the possibility of the lung on the involved side failing to expand after prolonged compression, a sufficient amount of abdominal viscera being within the chest to exert such a pressure.

There is no unanimity of opinion among surgeons as to which route affords the best approach to the hernia—through the chest, by way of the abdomen, or a combination of these methods. No matter which is adopted, one of the chief factors is undoubtedly that of obtaining an adequate exposure.

Previous to the suggestion of Dr. C. H. Mayo of inserting a tube through the hernia orifice, from abdomen to chest, and thus overcoming the negative pressure caused by the action of the diaphragm, the chief objection to the abdominal route was the difficulty of reducing the hernia. When the bowel is not adherent within the chest, it is indeed surprising to see how easily it can be reduced, once the suction action of the diaphragm has been overcome.

One of the factors opposing the transthoracic approach is the difficulty of replacing a considerable portion of the intestinal tract within an abdomen which for a long time has not adapted itself to containing this part of the bowel.

Of course if only a small portion of the bowel is involved such reduction might be readily accomplished from above, especially if after freeing any adhesions between intestine and chest or diaphragm, the edges of the opening in the latter be elevated, thus causing the intestine to be withdrawn into the abdomen, as has been advocated by others.

ACUTE MESENTERIC ADENITIS SIMULATING APPENDICITIS

APPENDICITIS, acute, subacute, chronic, etc., including stone and stricture of the ureter, intercostal neuralgia, and a host of other conditions incorrectly diagnosed as appendicitis, is an old story, and yet at the risk of repetition I wish briefly to discuss one of the more unusual conditions for which the appendix is unjustly blamed, namely, acute mesenteric lymphadenitis.

Orlando J., a white boy of ten years, was admitted to the Children's Hospital in May, 1929, complaining of pain in the lower right abdominal quadrant.

The history was one of acute tonsillitis six weeks previously, followed in about two weeks by what was apparently his first attack of acute polyarticular rheumatic fever. This condition cleared up and two days before admission he was apparently symptom free.

About forty-eight hours before admission he developed pain in the lower abdomen, more marked in the right side, accompanied by a feeling of nausea, for which an effectual purge was administered by his mother. The pain persisted and he was brought to the hospital.

Upon admission the child was apparently not suffering much, his throat had cleared up, and there were no joint pains. Physical examination was essentially normal aside from quite definite tenderness and increased muscular resistance on palpating the lower abdomen, especially on the right. There were no abdominal masses; the spleen could not be felt; rectal examination was negative, and there were no enlarged lymphatics in the neck, axilla, or groin.

Urine analysis was normal, and a blood-count showed 32,000 leukocytes, with 90 per cent. polynuclears.

The child had never before had a similar attack, and the question of course arose as to whether the condition present was appendicitis or should be attributed to his previous systemic infection. After watching him a few hours the tenderness and resistance in the lower right quadrant increased somewhat and his leukocyte count had increased 5000, the polynuclears still being 90 per cent.

In view of the fact that we have quite frequently removed acutely inflamed appendices in children presenting even less physical signs than were shown by the case under discussion, a tentative diagnosis of appendicitis was made, and it was decided that operation would involve less risk than delay.

Upon opening his abdomen, aside from moderate congestion of the serosa, the appendix was essentially normal and evidently not the cause of the trouble.

Exploration revealed that the lymph-nodes in the meso-appendix and in the mesentery varied from 3 to 11 mm. in diameter and were acutely inflamed. The appendix was removed and the abdomen closed without removing a lymph-node for examination, as it is a well-known fact that widespread peritonitis has been known to follow the removal of acutely inflamed mesenteric lymph-nodes, especially if the infection be of the streptococcus type.

Aside from a slight superficial wound infection which rapidly cleared up, the child ran a normal postoperative course. Three weeks after operation he was apparently symptom free, although his leukocytes still averaged 22,000.

It is not our intention to discuss the pathologic association between appendicitis and mesenteric lymphadenitis, and whether the appendicitis precedes the involvement of the lymph-nodes. This question, with a consideration of the etiology of the condition, has been very well summarized by Speese in the Pennsylvania Medical Journal for January, 1929.

Most writers on the subject agree that when the adenitis presents an acute onset, the condition is frequently mistaken for appendicitis and Speese cites 21 cases of this type which were operated upon for appendicitis.

In view of the fact that the acute type of mesenteric lymphadenitis so closely resembles acute appendicitis, we feel that operation is indicated in those cases presenting acute symptoms, even though it be revealed at exploration that the appendix is not the source of trouble. We have frequently observed that in children especially, the appendix may be acutely diseased in the presence of very slight symptoms.

ACUTE PERITONITIS FOLLOWING VULVITIS IN A CHILD

NANCY S., a white child of five years, was admitted to the Children's Hospital on June 2, 1929, her chief complaint being nausea and abdominal pain. Two weeks previously her three-year-old sister had died from what the family physician diagnosed as acidosis, which was preceded a few days by an acute streptococcic sore throat.

Up to the time of her present illness Nancy had been a healthy normal child, aside from a severe attack of acute vulvitis which developed just before her sister died. The vulvæ became greatly swollen and inflamed, the doctor stating that they looked like "raw beef."

This condition, with a moderately severe cystitis, responded to local measures and she was apparently comfortable one week before admission. At this time she complained of some discomfort in the upper abdomen, not associated with vomiting, accompanied by a rise of 1.5 to 2 degrees in temperature, which her doctor did not regard as being of much significance.

For forty-eight hours previous to her coming to the hospital she had been having spasmodic attacks of colicky pain which she referred to the region of her umbilicus, severe enough to make her cry, and of five to ten minutes duration. Her mother stated that these attacks occurred ten to twelve times daily and were more frequent on the day of admission. Her bowels had been moving daily without a purgative.

About eighteen hours before we saw her the child's condition had become much worse; she had been vomiting, and the abdominal tenderness and increased muscular resistance were more widespread.

On admission the child was in rather good condition and examination of the head and chest were essentially normal. The abdomen was not distended; there was very definite increase of tenderness and abdominal rigidity, especially in the lower abdomen, being more marked on the right, and peristalsis was scarcely audible. No mass was palpated, and rectal examination revealed some tenderness on the right side. The vulvæ presented evidence of a subsiding severe inflammation. The urine showed a cloud of albumin, a few hyaline and granular casts, and was positive for sugar. The leukocyte count was 14,000; temperature 103.4° F.; respiration 25; and pulse 118.

There was no doubt that we were dealing with a rather severe, widespread peritonitis, and as in the preceding case the question arose as to whether the appendix was the source of trouble or whether the infection had spread from the vulvæ.

We were again confronted with the anxious problem which besets all surgeons, namely, in border-line cases presenting the early stages of peritonitis of less than twenty-four hours' duration, whether to adopt expectant treatment or perform a rapid exploration and drainage. This question probably never will be decided to the satisfaction of even a majority of surgeons, and it has been our experience that when such cases have a fatal outcome we wish

that we had adopted the alternate procedure, no matter which method we may have decided upon.

In the present instance, in view of the fact that the child was in good condition—that the peritonitis was evidently of less than twenty-four hours' duration and that if it resulted from the infection of the vulvæ it was probably streptococcic in origin and, therefore, probably less apt to localize than are other types of abdominal infection (colon bacillus)—operation was decided upon, the preoperative diagnosis being probably an appendix which had ruptured at its base.

Upon opening her abdomen it was seen that there was thin, yellow pus throughout (culture showing that it was a vigorous growth of Streptococcus hemolyticus) much more marked in the pelvis. A moderately congested, essentially normal appendix was removed and to the exploring finger in the pelvis the tubes gave the impression of being somewhat enlarged. Two drains were placed in the pelvis and the abdominal incision loosely closed, the operation consuming only a few minutes. She stood the procedure well and reacted favorably for twenty-four hours, although her temperature remained 103° F. She then became distended and during the next four days gradually sank, in spite of blood transfusion, intravenous administration of dextrose and normal saline, pituitrin, and other supportive measures, dying on the fifth day after operation.

Postmortem abdominal examination revealed a plastic exudate throughout the abdomen with a localized collection of pus in the pelvis, the site of the appendectomy being normal. The tubes were about half again as large as normal and apparently the source of her peritonitis, the pathology on the right side being more marked than on the left. The endometrium was apparently the seat of a recent inflammatory process.

Unfortunately, a culture was not taken from either the uterus or lumen of the tubes. A blood-culture taken the day after operation, just before transfusion, showed a vigorous growth of Streptococcus hemolyticus within twenty-four hours.

When the blood-stream infection was reported, the question arose as to the advisability of administering a polyvalent streptococcus serum. I must confess that my experience with this type of serum in the presence of such a hematogenous infection

has been rather discouraging, so that when Dr. Reilly, the consultant internist in the case, suggested the transfusion instead of serum, no objection was raised as I regarded the chances of recovery as being almost hopeless in spite of any treatment.

As was mentioned earlier in this presentation, in view of the fatal outcome, it would have been of great interest to have seen whether the child would have lived had operation been deferred—a matter which is of course one of conjecture.

My own belief is that she was infected with the same strain of organism which killed her sister two weeks before; that the peritoneal infection was secondary to the vulvitis, by way of the uterus and tubes; and that in the presence of a virulent strain of Streptococcus hemolyticus infection of the peritoneum and bloodstream, a fatal outcome would have resulted from any form of treatment.

CLINIC OF DRS. WILLIS F. MANGES, EDWARD J. KLOPP, AND BRUCE L. FLEMING

JEFFERSON HOSPITAL

OSTEOGENIC SARCOMA OF THE TIBIA

WE will present and discuss 2 cases of osteogenic sarcoma of the tibia that have been under our observation and treatment for three and six years respectively. Clinically, roentgenologically, and histologically these are cases which are fairly authentic of this type of tumor. The diagnosis has not yet been verified by the Registry of Bone Sarcoma, but has been confirmed by Ewing.

Case I.—An adult white male, aged thirty-three years, was referred to one of us in July, 1926. He complained of pain and swelling of the left leg and knee and volunteered the information that in June, 1925 (a year previous) he was struck on the knee by a factory hand-truck. This was followed by pain and local swelling which lasted five or six days. The incident was lost sight of until November, 1925, when he began to have twinges of pain in this region at irregular intervals. Little discomfort was noticed between these attacks which increased in frequency and severity until June, 1926 when he first called on a physician. Because of the local swelling and tenderness rest in bed was advised.

There has been no malignancy in this man's family, but his maternal grandmother and two uncles died of pulmonary tuberculosis. His own health previous to this has always been good.

When first seen there was swelling of the left knee and leg most marked just below the joint. There was considerable local heat, hard or brawny edema, and slight discoloration; also tenderness on pressure. The swelling included the knee to a less extent, but a patellar tap was distinctly made out. The inguinal glands were palpable but not tender or noticeably enlarged.

Temperature 98.3° F.; pulse 80; respiration 20; hemoglobin 90 per cent.; red blood-cells 4,200,000; white blood-cells 6200; polynuclears 67 per cent.; lymphocytes 31 per cent.; basophiles 1 per cent.; eosinophiles 1 per cent. Urine and blood Wassermann were negative. A clinical diagnosis of osteogenic sarcoma of the tibia was made. He was referred for *x*-ray examination which brought forth the following report: "There is a destructive process

that we had adopted the alternate procedure, no matter which method we may have decided upon.

In the present instance, in view of the fact that the child was in good condition—that the peritonitis was evidently of less than twenty-four hours' duration and that if it resulted from the infection of the vulvæ it was probably streptococcic in origin and, therefore, probably less apt to localize than are other types of abdominal infection (colon bacillus)—operation was decided upon, the preoperative diagnosis being probably an appendix which had ruptured at its base.

Upon opening her abdomen it was seen that there was thin, yellow pus throughout (culture showing that it was a vigorous growth of Streptococcus hemolyticus) much more marked in the pelvis. A moderately congested, essentially normal appendix was removed and to the exploring finger in the pelvis the tubes gave the impression of being somewhat enlarged. Two drains were placed in the pelvis and the abdominal incision loosely closed, the operation consuming only a few minutes. She stood the procedure well and reacted favorably for twenty-four hours, although her temperature remained 103° F. She then became distended and during the next four days gradually sank, in spite of blood transfusion, intravenous administration of dextrose and normal saline, pituitrin, and other supportive measures, dying on the fifth day after operation.

Postmortem abdominal examination revealed a plastic exudate throughout the abdomen with a localized collection of pus in the pelvis, the site of the appendectomy being normal. The tubes were about half again as large as normal and apparently the source of her peritonitis, the pathology on the right side being more marked than on the left. The endometrium was apparently the seat of a recent inflammatory process.

Unfortunately, a culture was not taken from either the uterus or lumen of the tubes. A blood-culture taken the day after operation, just before transfusion, showed a vigorous growth of Streptococcus hemolyticus within twenty-four hours.

When the blood-stream infection was reported, the question arose as to the advisability of administering a polyvalent streptococcus serum. I must confess that my experience with this type of serum in the presence of such a hematogenous infection

has been rather discouraging, so that when Dr. Reilly, the consultant internist in the case, suggested the transfusion instead of serum, no objection was raised as I regarded the chances of recovery as being almost hopeless in spite of any treatment.

As was mentioned earlier in this presentation, in view of the fatal outcome, it would have been of great interest to have seen whether the child would have lived had operation been deferred—a matter which is of course one of conjecture.

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involving the left tibia just below the tubercle downward for 3 inches at least. Being purely destructive it resembles an acute tuberculous involvement. The patella is mottled and I believe involved" (not Dr. Manges' report).

We accepted the *x*-ray diagnosis and applied a silica cast immobilizing the knee. The cast was worn for eight weeks during which time the pain was not so severe. When the cast was removed the circumference of the leg had decreased ½ inch; there was more local heat and tenderness. Temperature

Fig. 422.—Note destruction of cortex, also small bone deposits in growth near upper end of lesion.

Fig. 423.—Anteroposterior view. When first seen.

99° F.; pulse 88; respiration 22; hemoglobin 80 per cent.; red blood-cells 4,000,000; white blood-cells 11,200. Clinically the lesion had increased in extent. He was referred to Dr. Manges for *x*-ray, September 14, 1926, who reported "osteogenic sarcoma of the upper end of the left tibia" (Figs. 422, 423). *x*-Ray treatments were begun. In a few weeks he left the hospital with his leg in a cast and was advised to use crutches. *x*-Ray report, Octo-

ber 20, 1926: "No increase in bone destruction. I think there is a little increased bone production." (M.)

There was gradual improvement clinically and roentgenologically until January, 1927. Sometime between November, 1926 and January, 1927 a pathologic fracture had occurred unknown to the patient. From an *x*-ray film made February 14, 1927 Dr. Manges thought the lesion was extending. Coley's toxin was considered but decided against. Patient was put to bed

Fig. 424.—There has been a pathological fracture. New bone formation as result of treatment.

at complete rest for a time and by May, 1927 *x*-ray again showed increased calcium deposit, also pathologic fracture (Figs. 424, 425). There was almost entire freedom from pain and gradual improvement until December, 1927 when another *x*-ray treatment was given and guarded use of leg was advised.

There was clinical and *x*-ray evidence of improvement as evidenced by lessened pain (only an occasional twinge), increased appetite, increase in

weight (8 pounds), more hours of sleep, and almost no local heat; increased density of bone in region of lesion from December, 1927 to May, 1928. Then there was more local discomfort again, though no real pain.

In October, 1928, the *x*-ray showed a new area of bone destruction at lower end of original site of tumor (Fig. 428). The leg below the joint had increased 1 inch in circumference; the soft tissues were hard and resistant to palpation, and there were many petechial skin hemorrhages. Another *x*-ray

Fig. 425.—Lateral view showing fracture and new bone formation.

Fig. 426.—Suggestion of recurrence of growth, treatment continued.

treatment was given the following month, but had no effect on the pain. Amputation was advised, but the patient withheld his consent. He was referred to Memorial Hospital, New York City, where diagnosis was confirmed and amputation again advised. Finally in February, 1929 he could no longer bear the pain and consented to operation. *x*-Ray of his chest showed no evidence of involvement. Nor was there involvement of the femur. A midthigh amputation was done. He was discharged from the hospital twenty-two days after the operation.

June 24, 1929 another *x*-ray of his chest was taken. The report was negative for evidence of lung metastasis. The patient has gained 12½ pounds in weight since he left the hospital. The stump is in excellent condition and is being molded for an artificial limb. There is no clinical evidence of metastasis.

Fig. 427.—Lateral view of Fig. 426.

Fig. 428.—New area of bone destruction at lower end of original site of tumor.

The following is Dr. Crawford's laboratory report:

"Case I.—Specimen: Tibia, left leg, and portion of thigh. Specimen consists of a left leg which has been amputated about the middle of the thigh. At the site of the amputation the skin is thick and edematous, but the cut surface of the bone and soft tissue appears normal. The knee-joint is swollen, but a definite mass is felt just below the knee which is hard and bone-like in consistency, and nodular, with a prominence on the external surface, and a sunken area on the internal surface, giving the impression that the bone has been bent outward. There is limited motion of the knee-joint with fixation

of the patella. The skin over the entire leg is thickened and edematous, and adherent to the bone just below the knee. The skin and subcutaneous tissue measure in places 1 cm. in thickness. On splitting the bone lengthwise, the femur appears normal. In the upper end of the tibia, the bone is soft and porous, containing small hemorrhagic areas. The marrow cavity cannot be recognized. In portions of the bone a soft gray-brown tissue is replacing the bony tissue, and the periosteum is roughened, and the surrounding tissue is

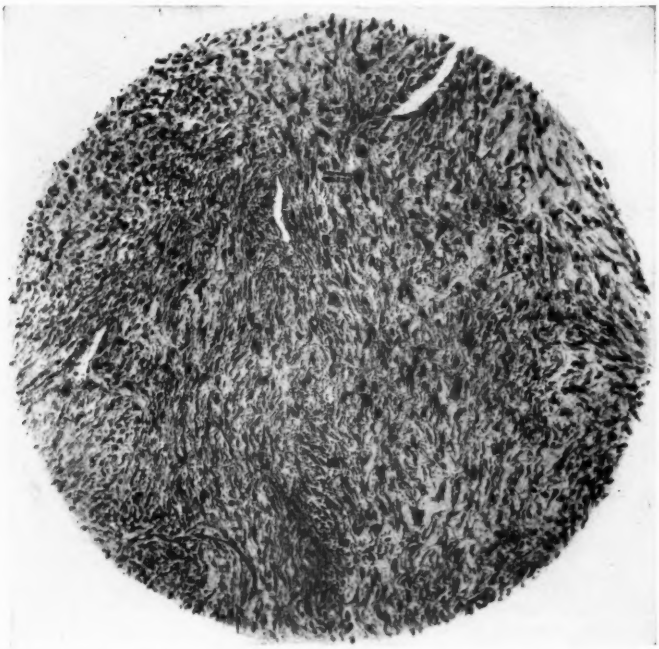

Fig. 429.—Case I. Microphotograph of section from the bone tumor. While the growth is not extremely cellular, the type of cells and the irregularity of their nuclei indicate the malignant nature of the tumor.

invaded by this soft, gray tissue. Just below the head of the tibia the bone appears to be fractured. On cross-section of the leg, about half-way between the ankle and knee, the bone and soft tissue appear normal.

"*Histology.*—Examination of sections from the upper portion of the tibia reveals that the normal bone structure has been largely replaced by rather cellular tissue in which there are spicules of bone. The cells forming the growth vary considerably as to size and shape, but the majority are spindle

shaped. There is considerable necrosis in small areas of the tissue. In parts of the bone the tumor tissue has penetrated the periosteum and is invading the surrounding muscle."

Diagnosis.—Osteogenic sarcoma of the upper portion of the tibia.

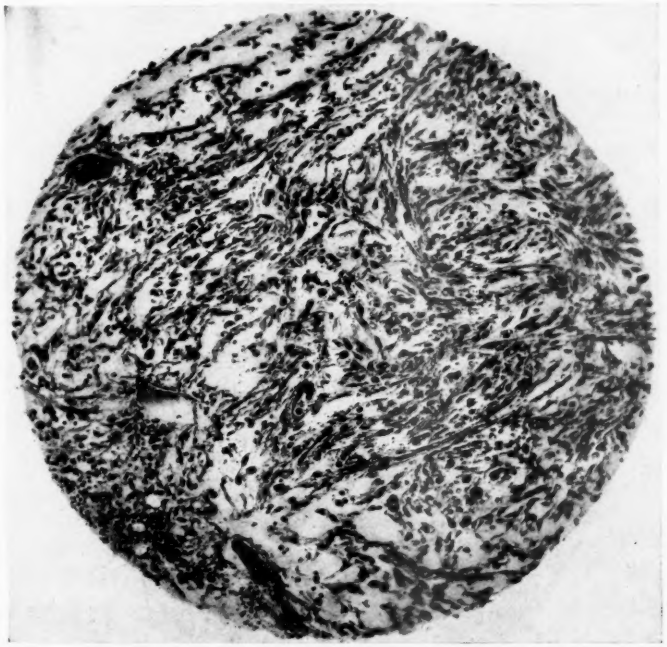

Fig. 430.—Case I. In another area of the tumor the tissue is of loose texture with numerous small blood-vessels and a few small areas of ossification.

Dr. James Ewing reported on the case as follows:

"A spindle-cell osteogenic sarcoma. It has a loose structure, somewhat peculiar, and is malignant. Without radiation, the patient ought to have pulmonary metastasis. It seems to produce a very small amount of bone."

Case II.—R. S., an adult white female, aged thirty years, was referred to this hospital by Dr. Creighton H. Turner, July 2, 1923, complaining of (1) pain and swelling of the right knee, (2) inability to use right leg. There was no history of malignancy in her family. General health has always been good. Married and has had six pregnancies with six children living and well. She has had no surgical operations. Several months before (exact date not known) patient states she fell and struck upon her right knee. This incident was en-

tirely lost sight of until some weeks later when pain began in the region of the right knee and she noticed some enlargement; she then associated this with the accident as cause and effect. Pain was now more or less constant, worse at night, increasing in intensity, and aggravated by weight bearing.

Physical Examination.—General appearance of patient was good. She seemed especially well-nourished. The eyes, head, and neck were negative.

Fig. 431.—Condition when first seen. Note complete destruction of cortex and no clear line of demarcation between healthy and disease portion of bone.

Fig. 432.—Note very slight deposit of bone showing outline of tumor, both in soft parts between tibia and fibula and also in the bone substance of the tibia.

The lungs were clear throughout. The heart was in normal position and functioned normally. There was no abdominal tenderness, nor any masses felt. No adenopathy detected. Pelvic examination was negative. Examination of skeletal structure was entirely negative except for the right knee and leg. The condition of the latter was described as being swollen, somewhat reddened, with increased local heat and distinct tenderness over the upper

end of the tibia. There was no fluctuation. Motion of the knee was restricted although not fixed. There was no evidence of fluid in the joint. The leg was held partially flexed on the thigh and there was increased pain on extension. Temperature 98.2° F.; pulse 84; respiration 22. Blood Wassermann and urine were negative. Blood-count showed nothing abnormal.

A clinical diagnosis of sarcoma of the right tibia was made and the patient was referred for *x*-ray examination of the knee, leg, and chest. The following report came to us. "Lateral view shows an extensive cavity in the medullary

Fig. 433.—Note progress of new bone formation in tumor.

portion of the head of the right tibia with thinning of the periosteum in the anterior portion. There is bone rarefaction of the patella and lower end of the femur. Anteroposterior view shows destruction of the external head of the tibia (Fig. 431). This is probably sarcoma. Chest: No *x*-ray evidence of metastasis."

The patient was hospitalized twenty-six days; our records show she had six hours of *x*-ray treatment. One week after the last treatment a silica cast was applied with leg in extension. Discharged July 28, 1923, with crutches.

Because her pain was not relieved she was readmitted August 6, 1923. During the brief period at home she claimed her leg was more painful than before the first admission to the hospital.

There was no increase in the circumference of the leg. Her general condition seemed excellent save for some trouble with her teeth which resulted in four extractions. The following month *x*-ray showed the area of bone destruction larger, but the margins more sharply defined. Dr. Manges advised delay in radical treatment. *x*-Ray treatment was continued.

Fig. 434.—Note continued increase, new bone formation three years after first treatment.

Fig. 435.—New bone very dense. Note beginning porosity of tibia below the old lesion.

On readmission, January 1, 1924, the pain had diminished. The circumference of the leg had not changed. The *x*-ray showed a marked improvement in the way of regeneration of bone in the tumor area (Fig. 433). One month later there was a decrease in the size of the leg by measurement, scarcely any pain, and increased function. This was approximately seven months after the first *x*-ray treatment. On account of the clinical and radio-

logic improvement the leg was regarded safe for weight bearing; a brace was advised and ordered.

April 2, 1924 patient was readmitted presenting no clinical change. Some increased heat was still noted over the tumor area. *x*-Ray showed increased calcification in the tumor.

She was readmitted June 30, 1924 free from pain with good knee and leg function. *x*-Ray of the right hip, lumbar spine, and pelvis negative. Dr. Manges expressed the opinion that he thought the lesion was arrested.

Fig. 436.—Beginning of breaking down in original site of tumor and also in shaft of tibia. Probably an entirely new process.

From June 30, 1924 to May, 1928 the patient was *entirely* free from pain and had good function. In this time she took care of her household and gave birth to a normal child (she had not consulted us about the latter). She was followed in the Out-patient Department from May, 1928 to July, 1928. During this period she complained of pain which became constant and was aggravated by motion. There was swelling (edema) of the leg particularly below the tumor.

We want to emphasize that the patient was symptom-free for nearly four years. Roentgenologically there was definite new bone formation (Aug. 24, 1926, Fig. 434; June 18, 1928, Fig. 435), although the latter depicts beginning porosity below the tumor.

Because the pain became more intense in the leg, knee, and lower thigh, hospitalization was recommended and she was readmitted December 14, 1928. *x*-Ray showed extension of the growth through the articular surface

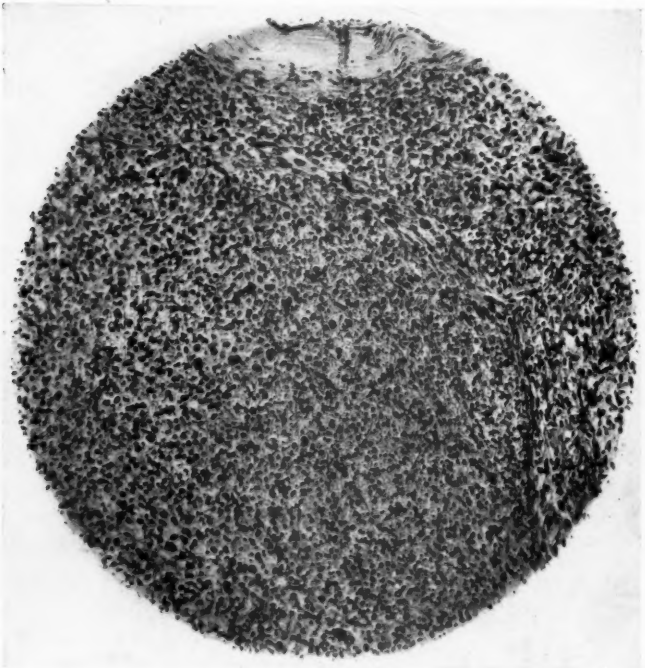

Fig. 437.—Case II. Microphotograph from section of tissue removed for biopsy. The cellular nature of the growth, the type of cell, and the irregularity of the cells and nuclei indicate definitely the malignant nature of the tumor.

of the tibia into the joint, also an extension downward in the shaft appearing somewhat like a separate growth (Fig. 436). The lungs were negative, roentgenologically and clinically. Passive motion of the knee caused severe pain. The circumference of the knee and leg was increasing, and the enlargement of the knee was becoming symmetrical. She now required analgesics for pain, although her general condition continued to be good.

Hemoglobin 78 per cent.; red blood-cells 4,240,000; white blood-cells 6000.

We had begun to doubt the original diagnosis of osteogenic sarcoma when she remained free from symptoms for nearly four years and from the encouraging *x*-ray films. Her symptoms and last *x*-ray report were conclusive evidence of rapid extension of the growth. In conference with Dr. Gibbon (through whose courtesy we were priviledged to follow the case) it was decided to do a biopsy. This was done after having obtained permission to do an amputation immediately or later, according to the surgeon's judgment.

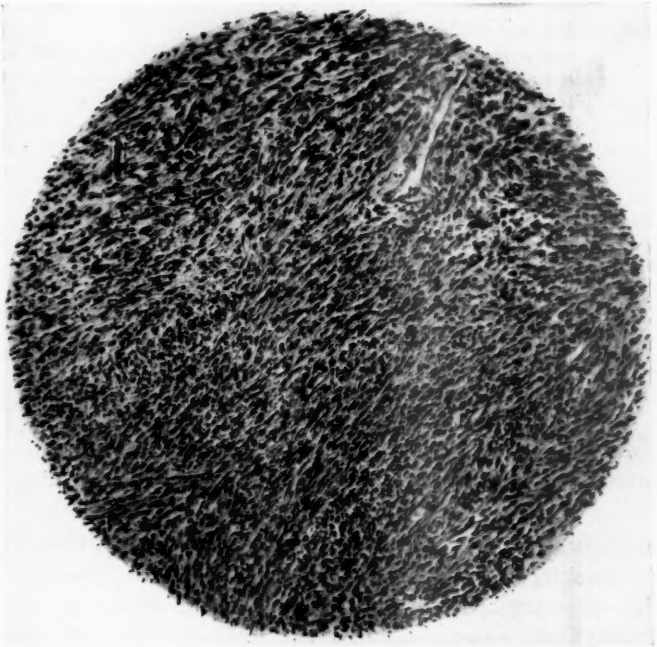

Fig. 438.—Case II. Microphotograph from section taken from another part of the tumor, where it involved the central part of the bone.

Biopsy, December 21, 1928. Nitrous oxid anesthesia. The most striking thing noticed was the large amount of soft, grayish, friable material which was found directly beneath the fascia. A small amount of this substance was removed from the depth of the growth for histological verification. Dr. B. L. Crawford, the pathologist, reported the tissue as malignant the following day, whereupon a midthigh amputation was done on December 22, 1928.

In July, 1929 she was well, getting along comfortably with an artificial

limb. There was no *x*-ray evidence of pulmonary metastasis. We have cautioned her against subsequent pregnancies.

The following is Dr. Crawford's laboratory report:

"Case II.—Specimen: Right leg. Specimen consists of a leg which has been amputated approximately 20 cm. above the knee. There is an operative incision through the skin and subcutaneous tissue from the knee downward, on the anterior aspect of the leg, exposing the upper end of the tibia. The skin and subcutaneous tissue are red, thickened, firm, and indurated. The surface of the bone is roughened.

"The leg, including the knee-joint, is sectioned lengthwise. In the upper end of the tibia the normal bone is largely replaced by a grayish, homogeneous, spongy tissue, containing bone.

"The tumor involves the center and periphery of the upper end of the tibia and the surrounding soft parts. The knee-joint is invaded and contains masses of soft, gray, friable tissue. The surfaces of both trochanters are eroded, but no evidence of involvement of the marrow cavity of the femur is observed.

"*Histology.*—Sections taken from the head of the tibia, and from the soft gray tissue around the bone, are composed of very cellular connective tissue which is vascular in areas. The cells forming the growth vary greatly as to size and shape; many are spindle, and many are oval, with numerous large mononuclear cells, and a number of large multinucleated cells. The nuclei of the cells are hyperchromatic and a number of the nuclei are undergoing mitosis. Small spicules of bone are observed in the tumor tissue, but actual bony formation is not observed. The tissue within the joint is largely necrotic, but in areas masses of tumor cells can be recognized.

"*Diagnosis.*—Osteogenic sarcoma of the head of the tibia."

Dr. James Ewing reported on this case as follows:

"This tumor of the tibia is a large spindle-cell osteogenic sarcoma. Some might call it fibrosarcoma, but I think it is quite cellular and malignant. This tumor generally arises from the periosteum and does not produce bone. Definite radiation effects are difficult to find. Without radiation this patient ought to have pulmonary metastases."

Discussion.—Osteogenic sarcoma must be differentiated from rheumatism, tuberculosis, syphilis, osteitis fibrosa, bone cysts, giant-cell tumors, myeloma, Paget's disease, aneurysm, chondroma, Ewing's sarcoma, and osteomyelitis.

You will note that the first case was erroneously diagnosed roentgenologically as tuberculosis, by a young, and splendid *x*-ray man. Clinically, it was not tuberculosis because the enlargement in or near such joints is symmetrical, and in osteogenic sarcoma it is asymmetrical. Articular cartilage is very resistant to sarcomatous invasion, hence joint involvement does not occur early. It had not occurred in the first case, and not until five years after the onset in the second case. Repeated roentgenograms

when the first did not coincide with our clinical views might have avoided an error. Clinicians and roentgenologists must familiarize themselves with many and varied roentgenograms of all sorts of bone lesions in order to more accurately diagnose these conditions. Limbs have been needlessly sacrificed for chronic inflammatory conditions or benign tumors.

As we were dictating these notes a spinster of sixty from another city was referred with an *x*-ray diagnosis of sarcoma of the tibia. We referred her to Dr. Manges who from his films suspected Paget's disease. Further study of the pelvic bones confirmed his diagnosis. There was no evidence of sarcomatous change. Osteogenic sarcoma seldom occurs in persons over fifty in previously healthy bone. It does occur not infrequently in Paget's disease, and then usually later in life. We have not knowingly seen a case of sarcoma in Paget's disease.

Biopsy in cases of osteogenic sarcoma has been condemned. We did it in the second case as our diagnosis was becoming doubtful, the patient having been symptom-free for four years. Amputation was done within twenty-four hours of the removal of the specimen. The wound was not cauterized.

The publications by Codman and Kolodny have done much to clarify our understanding of malignant bone tumors.

Pathologic fracture (Case I) is a common occurrence. In fact, it not infrequently is the first symptom which sends the patient to a physician who by *x*-ray finds the cause of the fracture. Fractures, on the other hand, often occur and the patient is not aware of it. That is what happened here. Union of such fractures may take place, in fact it did so in this man. Histology showed much more bone structure than in Case II.

The interesting features regarding these cases are the relief of pain and apparent improvement following *x*-ray treatment. The woman (Case II) was so well and so free from symptoms for nearly four years that, as we have stated before, we began to doubt the diagnosis of sarcoma. Not until the latter months of pregnancy did the tumor show signs of renewed activity. Are we justified in believing that pregnancy was a factor in stimulating growth of the tumor? Subsequent to the pregnancy the

tumor failed to respond to *x*-ray treatment. The symptoms became steadily worse until relieved by amputation.

The man also was relieved for two periods by *x*-ray treatment. Temporary relief by *x*-ray in osteogenic sarcoma is a common occurrence. The roentgenologic improvement, however, is not as striking as in cases of Ewing's sarcoma, nor is the effect so lasting. We believe that all suspected cases of bone sarcoma should be treated with the *x*-ray. It will aid to differentiate Ewing's sarcoma from a sclerosing or subacute osteomyelitis; the former responding promptly, the latter showing no change. Furthermore, osteogenic sarcomas may be improved temporarily and possibly the likelihood of early metastasis lessened. Reported cures of osteogenic sarcoma by *x*-ray treatment without histologic confirmation are subject to doubt and criticism.

The use of Coley's toxin was considered; the patients were told about the uncertain result and the reactions. They both declined its use. We believe that we have seen beneficial results from the use of Coley's toxin in sarcoma of soft structures, but not in cases of sarcoma of bone. We usually recommend it particularly in the virulent type cases.

The fact that Case II is alive more than six years after onset of symptoms is not an assurance that she may not ultimately succumb to pulmonary metastasis. Prophylactic *x*-ray treatment of the lungs has been recommended; also of other parts of the body. It is true that sarcomatous metastasis of the lungs often responds dramatically to *x*-ray, but we cannot approve of it as a prophylactic measure.

We have had no experience with radium in the treatment of osteogenic sarcoma, therefore cannot discuss its use.

It would seem that sarcoma occurring some years after epiphyseal ossification is less malignant than during the second decade of life. Age may be an important factor in the rather hopeful outlook in our cases. It cannot be said that the patients were managed to the best advantage at all times. They will be followed and the Registry will be notified of any important change.

CLINIC OF DR. ALBERT E. BOTHE

UROLOGICAL DEPARTMENT, MISERICORDIA HOSPITAL

CARCINOMA OF THE PROSTATE

THE nature of benign hypertrophy of the prostate has been a subject of much discussion. It has been regarded by some as adenomatous tumor formation, while others contend it is a diffuse hyperplasia of the glandular and interstitial tissues. It is, however, generally accepted that glandular vesical neck obstruction may arise in the true prostatic tissue or in the subcervical glands with compression of the prostate gland. This conclusion seems justifiable from the studies of Zuckerkandl, Tandler, Motz, and Perearneau. Randall, after studying a large series of autopsy specimens, concluded that hypertrophies may involve one solitary lateral lobe, solitary commissural tissue, solitary subcervical tissue, or combinations of any two of these or all them together.

In this communication 2 cases will be presented. The first illustrates adenocarcinoma arising in the subcervical glands, the second adenocarcinoma arising in the compressed prostate tissue associated with benign hypertrophy of the subcervical glands.

Case I.—The patient, a white male, seventy-six years of age, was admitted to the Misericordia Hospital with a chief complaint of inability to void. The patient had frequency of urination and nocturia for ten years. During the past year he had had to void four or five times a night. Occasionally there was burning on urination, but never was there any evidence of blood in the urine. The night before admission to the hospital he had the first attack of complete retention. A catheter was introduced into the urinary bladder by the family doctor, who sent him to the hospital the following day. On admission he had retention with some overflow dribbling.

Physical Examination.—The patient was a thin, fairly well-nourished, somewhat dehydrated, white male, seventy-six years of age, who was not acutely ill. The physical findings were essentially negative except for the

heart and prostate. The heart was slight enlarged. There was a loud systolic murmur at the apex which was transmitted to the axilla, and a soft presystolic murmur in the same region.

The prostate per rectum was enlarged, grade three. It was symmetrical, soft, smooth, and boggy. No nodules could be palpated.

Studies and Preoperative Care.—A soft rubber catheter was easily introduced and the bladder decompressed in the usual manner. A trace of albumin and an occasional granular and hyaline cast was found in the urine. Phenolsulphonephthalein was given intravenously. It appeared in the urine in eight minutes. The first specimen contained 30 per cent. of the dye, and the second 20 per cent. The blood-pressure was 130 systolic and 84 diastolic. Several examinations of the blood-urea nitrogen and non-protein nitrogen revealed no retention of these products.

Dr. Sweeney reported the following electrocardiographic study: Graphic interpretation—extra systoles of ventricular origin, moderate left ventricular preponderances. Records of this type are associated with myocarditis, although, graphically there is nothing to indicate an unusually bad prognosis.

Upon cystoscopic examination, an intravesical bulging of both lateral walls and a deep anterior notch at the bladder neck was seen. There was no bleeding. The bladder was drained per urethra for eleven days, during which time the patient was up and around.

Operation.—Under sacral, transsacral, and suprapubic block anesthesia, a suprapubic prostatectomy was performed. No difficulties were encountered. The prostate was easily enucleated and there was very little bleeding.

Pathologic Examination.—The specimen measured 6 x 5 x 4 cm. It was well encapsulated and boggy. On section it was pale and showed whirls of fibrous tissue and many retention cysts. Several microscopic sections were studied from different areas. All sections were typical of the appearance of benign hypertrophy of the prostate with chronic interstitial prostatitis. These sections have since been studied and give no evidence of malignancy.

Postoperative Course.—After operation, the patient made an uneventful recovery. The suprapubic wound was completely closed in twenty-seven days and the patient discharged twenty-nine days after operation. He was voiding freely and had no residual urine. He was referred to his family doctor for further treatment and observation.

Four months after discharge, the patient was again admitted to the Misericordia Hospital with a chief complaint of sudden onset of hematuria and difficulty in voiding. The difficulty in voiding was found to be due to large blood-clots in the bladder. Permanent bladder drainage was established with a soft rubber catheter per urethra. In two days the urine was again clear and free from blood. Upon cystoscopic examination a large, very much reddened ulcerating surface was seen in the region of the prostatic bed. Per rectum, there was some induration and thickening of the tissues between the index-finger and the cystoscope. The findings were thought to be due to granulation tissue in the prostatic bed, with the bleeding due to rupture of a small blood-vessel. In seven days the catheter was removed. The patient again voided freely with no evidence of blood in the urine. He was discharged and again referred to his family doctor.

Six months after his second admission the patient was again sent to the hospital with a chief complaint of sudden onset of hematuria and difficulty in voiding. The bladder was drained with a permanent catheter. This relieved some of the vesical neck discomfort, but the bleeding continued. The patient's general condition was very poor. The blood chemistry studies gave evidence of nitrogenous retention. All methods for activating elimination were instituted with little or no response. The patient died twelve days after admission. An autopsy examination was made.

Autopsy.—It is not proposed to consider the complete autopsy findings. Only those which have a direct bearing upon the subject presented will be

Fig. 439.—Microphotograph of tissue removed from vesical neck at operation in Case I. This section illustrates benign hyperplasia of the sub cervical glands.

given. A large, moderately firm, apparently granulating lesion was found in the prostatic fossa. It was irregular in outline, and extended up to the base of the bladder. Posteriorly, it involved the rectal surface, but not the wall. The regional lymph-glands were enlarged. Tumors were found in the liver and lungs which were interpreted as metastatic carcinoma. The bones were thoroughly examined for evidence of metastasis, but no metastasis was seen.

Microscopic sections made from the indurated tissue in the prostatic bed were typical of adenocarcinoma of the prostate. The epithelial cells were small and irregular in form and arrangement. There were many free

epithelial cells in the dense fibrous stroma. A number of mature and immature blood-vessels were seen throughout the stroma. Sections made from the regional lymph-glands, lung, and liver were characteristic of metastatic adenocarcinoma.

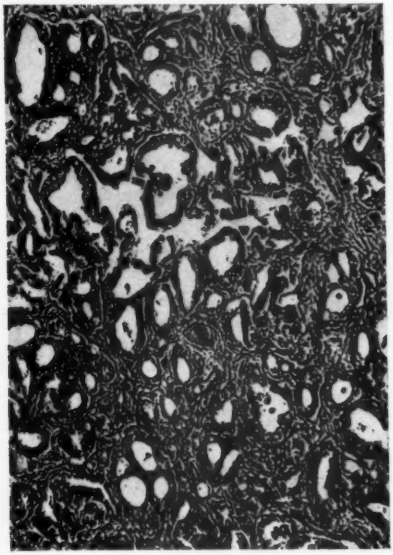

Fig. 440.—Microphotograph of carcinoma of the compressed prostatic tissue in Case I.

Case II.—The patient, a white male, seventy-nine years of age, was admitted to the Misericordia Hospital with a chief complaint of inability to pass urine. Frequency of urination and nocturia, three to four times, had been present the past four years. Hematuria was never observed. The acute retention at the time of admission was the third attack. On the two previous occasions, urination occurred after catheterization. For the past two years, there had frequently been difficulty in starting the urinary stream.

Physical Examination.—The patient was a thin, well-nourished, strong, white male, seventy-nine years of age. He did not appear acutely ill. The physical findings were essentially negative except for the prostate.

Prostate.—Per rectum the prostate was very large. The index-finger could not be passed over the top. It was soft, symmetrical, and boggy. No nodulation of the prostate was palpable.

Studies and Preoperative Care.—A soft rubber catheter was easily introduced and the bladder decompressed in the usual manner. A trace of albumin and many leukocytes were found in the urine. The erythrocyte

count was 4,500,000. The hemoglobin was 85 per cent. Several examinations of the blood for urea nitrogen and non-protein nitrogen revealed no retention of these products. The blood-pressure was 100 systolic and 70 diastolic. The preoperative care was carried on in the usual manner over a period of seventeen days with the patient out of bed.

Operation.—Under sacral, transsacral, and suprapubic block anesthesia, a suprapubic prostatectomy was performed. The prostate was large with considerable intravesical bulging. A line of cleavage was easily obtained and the gland was enucleated with very little difficulty. There was very little bleeding encountered.

Pathologic Examination.—The specimen was well encapsulated. It measured 7 x 5 x 4 cm. On section the tissue bulged and was soft and friable.

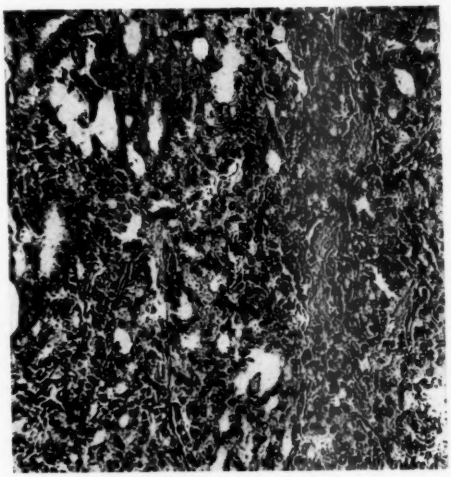

Fig. 441.—Microphotograph of carcinoma of the subcervical glands in Case II.

There were present here and there small necrotic areas. Microscopically the tissue was made up almost entirely of epithelial cells. There was very little stroma. The epithelial cells were irregular in form and arrangement. Diagnosis: very malignant adenocarcinoma.

Postoperative Course.—The patient made an uneventful recovery. The suprapubic wound was closed seventeen days after prostatectomy. He was discharged from the hospital twenty-three days after operation. He was referred to his family doctor for care, and advised to continue with *x*-ray therapy. He was last heard from seven months after his discharge from the hospital. At that time his general condition was fair, but there was some evidence of partial urinary obstruction.

Discussion.—Although there were no preoperative symptoms of carcinoma of the prostate in either of the cases presented, there have at times been findings in this type of case that are suggestive of a carcinomatous lesion. The literature indicates that carcinoma at first and probably for a long time is symptomless. The average period of survival after the onset of symptoms is usually short. The period of symptom-onset is variable owing to the variability of the location of the lesions in the gland. Roberts' cases illustrate that extensive metastasis may occur before the first symptoms are noted. When symptoms do occur they are urinary and in no way characteristic, as is illustrated by the cases presented. Distant, extravesical pain associated with urinary symptoms should always be considered suspicious of metastasis, especially when urinary symptoms are present. Hematuria is of no significance. Young pointed out that hematuria is more frequent in benign hypertrophy than in carcinoma of the prostate.

In general, it may be stated that carcinoma of the prostate may be symptomless for a long time. When symptoms are present, they are usually those due to urinary obstruction and cannot be differentiated from those of benign hypertrophy of the prostate unless the gland be found stony hard and nodular. Even then the findings are only suggestive. The only means of accurately diagnosing carcinoma of the prostate, especially when early, is to subject all available tissues to extensive histologic study.

Primary carcinomatous growths of the prostate from a clinical point of view may be divided into (1) those with urinary obstructive symptoms with no evidence of metastasis, (2) those with symptoms from metastasis with little or no evidence of a primary lesion, and (3) no evidence of malignancy before pathologic study of the surgical specimen. In Group I the gland per rectum is usually stony hard and nodular. In Group II the symptoms are variable. They manifest themselves by pathologic fractures, osteoplastic growths, pleural pains, central nervous system pressure, or anemia. In this group the primary lesion remains obscure until an autopsy is performed. In Group III the carcinom-

atous lesion of the prostate is recognized in the course of routine pathologic studies of the surgical specimen. Hirsch and Schmidt found that extensive sectioning of prostate specimens frequently demonstrated concealed small carcinomatous lesions which were not suspected, either from the symptoms, physical findings, or gross examination of the surgical specimen.

Histologically, all primary prostate cancers are adenocarcinomatous in nature. There may be several different types of growth which could hardly represent different tumors since various combinations may be found in the same tumor. In the cases presented, however, there was a distinct difference in the histologic appearance.

In the first case, the epithelial cells were arranged in definite and indefinite acinar formation. The cells were small and somewhat irregular. The fibrous stroma was abundant and many of the epithelial cells were found in its meshes. In the second case the epithelial cells were larger and very much more irregular in form and arrangement. The stroma, however, was very scant. The histologic sections made from the first tumor simulated a scirrhous lesion, those made from the second tumor simulated a medullary lesion. This difference may be due to degree of malignancy. It is my feeling, however, that the difference is not one of degree of malignancy, but a difference in the type of glandular origin.

In the first case presented, the obstructing tissue removed at operation was, no doubt, a benign hyperplasia of the subcervical glands with false capsule formation and compression of the true prostate tissue. The adenocarcinomatous lesion was probably present in the compressed tissue at the time of operation, but was activated by manipulation at the time of prostatectomy.

In the second case, one cannot be absolutely certain, but it seems justifiable to assume that an adenocarcinoma of subcervical gland origin was the seat of the primary lesion with compression of benign prostatic tissue. The striking difference in the histologic appearance along with the difference in the location of the lesions is the reason for assuming that they illustrate

two different regions of onset, the first from compressed prostate tissue, the second from the subcervical glands.

Conclusions.—These cases are presented to illustrate, first, the development of primary adenocarcinoma within the subcervical glandular region with no clinical evidence, second, the development of adenocarcinoma in compressed prostate tissue activated by removal of benign glandular hyperplastic tissue.

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CLINIC OF DR. I. M. BOYKIN

FROM THE SERVICE OF DR. A. P. C. ASHHURST, EPISCOPAL HOSPITAL

SPINAL ANESTHESIA

SPINAL anesthesia has in the past few years found a place in many clinics throughout the country. In this clinic we began its use several months ago, and to date has been given in 70 cases. The operations in this series covered only the part of the body below the diaphragm. Not until I am more familiar with its use will it be used for any operation higher than this level. All these cases were anesthetized by me personally in an effort to master the technic, on which the results depend and, if possible, to determine the cause of complications when they arose. Spinocain, developed by Pitkin, was used routinely and his technic followed except in some few details. The series is too small to permit the expression of a definite opinion or to discuss those expressed by others, but on the whole the results have been very pleasing. Spinal anesthesia, to me at least, has simplified abdominal surgery in no small degree. This is due to the relaxation and to the cessation of abdominal breathing.

The technic used is briefly this: a table is set up containing a small basin of sterile water, a package each of sterile sponges and towels, 70 per cent. alcohol, 2 per cent. picric acid and alcohol, 2 ampules ephedrin-novocain solution, 2 ampules spinocain, 1 hypodermic needle 1 inch, 1 hypodermic needle 2 inches, one 20-gauge Pitkin spinal puncture needle, one 2-c.c. syringe, one 4-c.c. syringe, one 10-c.c. syringe. The night before operation the patient's lower bowel is cleansed by a saline enema and he is made to void just before being sent to the operating room. This prevents involuntary defecation and urination while on the table.

One-quarter grain morphin sulphate and $\frac{1}{200}$ gr. hyocin are given hypodermically one hour before operation. To give the anesthetic the patient is placed in the sitting posture on the operating table with legs over the side. The spine is flexed and an attendant standing in front of the patient holds him in this posture. The lumbar region, which has been previously shaved if need be, is scrubbed with alcohol, dried and painted with 2 per cent. picric acid. The field is surrounded with sterile towels. The interspace through which the puncture is made, usually between the second and third lumbar vertebræ, is marked. The 2-c.c. syringe is filled with the ephedrin-novocain solution, 1 or 2 ampules as indicated, and with the small hypodermic needle, a wheal is made over the marked interspace. The longer hypodermic needle replaces the short one and the intraspinous ligament is infiltrated. The spinocain, 2 to 4 c.c. as indicated, is then placed in the 10-c.c. syringe, the spinal puncture done and an amount of spinal fluid withdrawn equal to the amount of spinocain to be injected. This spinal fluid is thrown away. The 10-c.c. syringe containing the spinocain is then attached to the spinal puncture needle and with one stroke of the plunger the amount of spinal fluid, 2 to 6 c.c., depending upon the height of the anesthesia desired, is diffused with the spinocain. This mixture is then injected with one stroke of the plunger, the needle quickly withdrawn, and the patient placed in the recumbent position, *i. e.*, with 5-degree Trendelenburg. This procedure takes fewer seconds than does the spinocain to rise to a higher level than desired. The external auditory canals are then tamponed with cotton and the eyes covered with vaseline gauze. In some patients the noise of the operating room and the never-before-seen surroundings cause excitement. In fifteen minutes from the time of injection, anesthesia should be well established if there has been no break in technic.

The sitting posture is used contrary to the technic of somé, especially Pitkin, but I have found it much easier to do a spinal tap in this posture. The danger of using the sitting posture is overcome by using a large syringe, diffusing the desired amount of spinal fluid with one stroke, and injecting the diffused fluid with

one stroke and immediately placing the patient in a 5-degree Trendelenburg.

The usual dose of spinocain, 2 c.c., does not give an anesthetic lasting over one hour, which for the average operator is not long enough for some abdominal operations. In operations which may require more time than this, 4 c.c. is used. This dosage will give anesthesia lasting from two hours to two hours and twenty minutes. Although this is double the amount advocated, I have seen no ill effects from its use.

The level of the anesthetic is determined by the amount of the spinal fluid diffused with the spinocain. For a hernia a diffusion of 2 c.c. of spinal fluid is sufficient, for upper abdominal work at least 6 c.c. is required. It has been noted that the level of splanchnic and skin anesthesia do not coincide. That of the skin is always higher. In order to insure complete splanchnic anesthesia, the level of the skin anesthesia should be up to the nipple line.

There were 3 cases in this series in which there was a failure to get anesthesia due possibly to extradural injection of the spinocain, which in turn is due to a displacement of the needle during manipulation. In 1 case with a fusion of the lumbar vertebræ, due to an old spondylitis, a dry tap was obtained. This patient later developed a cold abscess at the site of the puncture and another which pointed in the groin.

The only immediate symptoms noted following the injection have been nausea and sweating. These were transitory, only lasting for a few minutes, being relieved by oxygen and CO_2 inhalations. In one case, a very fat woman, profound shock followed immediately. The operation was postponed and treatment for shock instituted. She recovered and was operated upon later under general anesthesia.

In the beginning not a few cases developed a reaction manifested by rapid pulse, increased respirations, profuse sweating and anxiety. These cases were placed in bed on removal from the operating table without elevation of the foot. This reaction has been overcome by keeping the patient in a Trendelenburg position for three hours after leaving the operating table.

In no instance has there been involuntary defecation or urination as has been the complaint from some clinics. This can be accounted for by purgatives not being used in the preoperative treatment, the lower bowel being cleansed by an enema instead.

There were no deaths in this series that could be attributed to the anesthetic.

LYMPHANGIOMA OF THE AXILLA AND UPPER LIP

Case I.—A child, M. K., age six years, was admitted 12/4/27, complaining of a painful swelling in the left axilla of five days' duration. On examination, her temperature was 102° F. There was a tender, reddened, fluctuating swelling in the left axilla extending forward and upward beneath the left pectoral muscle. The condition was thought to be a subpectoral abscess. Under ether anesthesia the mass was opened, a large quantity of straw-colored fluid containing flocculent masses was evacuated. Culture and smear taken, the cavity drained. Both culture and smear showed cocci. After several days the drain was removed followed promptly by healing of the wound. After an interval of three weeks the fluid had reaccumulated. A diagnosis of lymphangioma was then made and operation for its removal advised.

Under general anesthesia the axilla was opened by an incision along the free border of the pectoral muscles extending down the inner side of the arm to the level of the insertion of the deltoid. The mass was in intimate relationship with the structures of the axilla and extended forward beneath the pectoral muscle and upward to the clavicle. Removal was accomplished without rupture. The wound closed and the axilla drained through a stab wound in its base. Another culture and smear at this time also showed cocci. Convalescence was interrupted on the fifth or sixth day by the development of a lymphangitis of the skin lymphatics, as evidenced by reddened streaks extending in all directions from the wound margins. This subsided with the application of cold and the patient discharged as cured.

Though clinically, this was lymphangioma, the pathologist, Dr. C. Y. White, histologically could not differentiate it from a brachial type of cyst.

Case II.—In 1919, a boy came to me complaining of a swelling of his upper lip. He stated that several months ago he had been stung on the lip by a bee, that the resulting swelling had never subsided, and the lip was gradually getting larger. On examination the lip was markedly everted and several times its normal thickness. To touch, there was no induration and the mass could only be outlined by inspection. Operation was advised and the tumor excised through a longitudinal excision made through the mucosa just below the vermilion border. Histologic examination showed it to be a lymphangioma.

Lymphangiomas are tumors composed of lymph-vessels (Ewing, 1928). They may be congenital or acquired, occurring in any part of the body where there are lymph-vessels.

Wagner (1894) first discovered the histologic structure of these tumors and recognized three groups of cases: (1) Lymphangioma simplex, consisting of an anastomosing network of

spaces and vessels of small calibre. The endothelium is flat or cuboidal and rarely appearing in multiple layers. (2) Lymphangioma cavernosum, consisting of a system of communicating lymphatics lined by flat epithelium and filled with coagulated lymph mixed with blood. (3) Lymphangioma cystoides, consisting of congeries of large and small cysts lined with flattened endothelium and filled with lymph.

Most of the lymphangiomas fall into the cavernous type. There not infrequently occurs a new growth of blood-vessels not communicating with the lymphatics forming a hemolymphangioma. Wagner believes there are three modes of origin: passive dilatation with inflammatory hyperplasia of pre-existing vessels, neoplastic growth of vessels, and heteroplastic formation of lymph-vessels in granulation tissue.

It would seem likely that infection does play a part in the formation of some of the acquired types as is suggested by the first case described above. In the second case we might assume that the hyperplasia of the lymph-vessels was set up by the irritating effect of the formic acid injected by the stinger of the bee.

CARCINOMA OF THE ESOPHAGUS

F. C., age fifty-seven years, admitted 12/1/27. Patient stated that one year ago he had difficulty in swallowing solid food. This lasted for several days and then disappeared. Six months later he had another attack similar to the first and from this time on until the present date the attacks became more frequent, occurring every few days. Recently he has begun to vomit and at times even water will not stay down. In October, 1927 his family physician sent him to the clinic of Dr. Chevalier Jackson. Examination with esophagoscope at this time showed an ulceration of the esophagus at the junction of the middle and lower third. A biopsy was done and the condition reported as ulcerative esophagitis, malignancy questionable. He again visited Dr. Jackson's Clinic in November, 1927 and a second biopsy done. This was reported as squamous-cell carcinoma. On 12/3/27 a gastrostomy was done under local anesthesia by the method of Stamm. Patient discharged 12/17/27 improved. After his discharge from the hospital he was kept track of through his family physician and the end-result clinic of the hospital. He remained comfortable and in good state of health until April, 1929 when he was suddenly seized with severe substernal pain, death occurring shortly thereafter from a pulmonary abscess, the result of the perforation of the esophagus.

Carcinoma of the esophagus is characterized by its frequency, the esophagus ranking fourth to all organs as a site of cancer, obscurity of early symptoms, variety of lesions, peculiarity of structure, and a high mortality. Males are effected in 75 per cent. of cases, the age incidence is about fifty to sixty. The youngest case recorded is nineteen, the oldest ninety. The factors which very likely contribute to its development are alcohol, irritating foods, coarse unmasticated foods, leukoplakia, tuberculosis, and peptic ulcers. The anatomy of the esophagus has an important bearing on the location and incidence. There are three points of predilection, *i. e.*, the normal constrictions. Other points where it commonly occurs are at the level of the cricoid, aortic arch, tracheal bifurcation, left bronchus, and cardia. In most cases of carcinoma of the esophagus coming to autopsy, abnormalities of the mucosa are found. Congenital defects such as canalization of the submucosa and muscular coats are thought to have some bearing on the development.

The tumors appear as flat infiltrating ulcers, as polypoid masses, and occasionally as diffuse infiltration, the entire organs being involved. The growths are usually of the epidermoid type presenting squamous cells, referred to by some pathologists as acanthoma. Adenocarcinoma with mucous production does occur.

As a rule, relief is not sought until late in the disease. The diagnosis here can usually be made on clinical symptoms. Early in the disease diagnosis can only be made by the esophagoscope and *x*-ray, other measures are inconclusive.

Previous to the days of gastrostomy, bouginage was the method of treatment. It is used by some today in selected cases. Vincent, of Rochester, believed it superior to gastrostomy. Reports from the use of radium and deep *x*-ray therapy are not encouraging.

Sedillot did the first gastrostomy in a human in 1849. From this time on, its popularity as a palliative measure in carcinoma of the esophagus increased until the beginning of the present century when it began to be replaced by intubation and radium. It is now coming back into use. Müller and Brill report 21 cases of gastrostomy for carcinoma of the esophagus with the primary mortality of 11.8 per cent.

At the present time there is nothing to be said in favor of the radical operation; the mortality is 100 per cent.

Recently I have looked up the cases of carcinoma of the esophagus admitted to the Episcopal Hospital since 1924. There are 17 in number. Since reviewing these cases I have found that in one there was an error in diagnosis; suspicion was aroused by the fact that the patient lived so long and improved so markedly in general health following gastrostomy. Originally, the diagnosis was made on clinical evidence and *x*-ray. On checking up, an esophagoscopic examination was done and the condition was found to be a diverticulum. A brief review of the remaining 16 cases is as follows:

All were males with the average age of fifty-nine years. The location of the lesion in 9 was at the level of the sixth dorsal vertebra, 1 at the eighth dorsal, 1 at the third dorsal, 1 at

the cardia, and in 4 the location was not determined. Eleven cases were treated by gastrostomy, the remaining 5 being so far advanced nothing was done. Of the 11 gastrostomies there were five house deaths, a mortality of 45.5 per cent. The average length of life of these 5 cases was thirty days. The average length of life for the 11 cases of gastrostomy was one hundred and four days.

Gastrostomy should not be delayed. If the patient is allowed to go until he can no longer take food, the probabilities are he will not withstand the operation.

CLINIC OF DR. JOHN B. FLICK

SERVICES OF DR. JOHN H. GIBBON, PENNSYLVANIA AND JEFFERSON HOSPITALS

THORACIC SURGERY

EXTRAPLEURAL THORACOPLASTY IN THE TREATMENT OF PULMONARY TUBERCULOSIS

THE benefit of collapse of the lung by means of thoracoplasty has been accepted as a successful method of treatment in certain types of pulmonary tuberculosis, and in recent years has attracted widespread interest. With increasing experience the group of cases regarded as suitable for thoracoplasty is becoming larger and the technic standardized. I wish to show you 2 cases, both of which presented conditions necessitating a rather more extensive operation than is usual in the ordinary thoracoplasty for pulmonary tuberculosis.

Case I.—This patient, a white woman, thirty years of age, had been under treatment for chronic pulmonary tuberculosis for ten years. As you can see she is well-nourished and does not appear ill. Yet an *x*-ray examination (Fig. 442) made before operation showed an extensive tuberculosis of the right lung with large cavities in the upper lobe, pulling over of the mediastinal structures, elevation of the diaphragm, and some contraction of the chest wall. She ran a low grade fever, and had a productive cough with expectoration of over 3 ounces per day, which on examination showed numerous tubercle bacilli. Her left lung showed no unhealed tuberculosis, and as far as we are able to tell has remained in good condition. We regarded her as a suitable case for thoracoplasty, but realized that it would be difficult to obtain a complete collapse of the cavities in the right upper lobe. The first stage of a paravertebral extrapleural thoracoplasty was performed on October 25, 1928. The upper ribs were exposed under infiltration anesthesia, but chloroform anesthesia was given during the stripping and resection of the ribs. Fifty-two cm. of the ribs, from the first to the sixth inclusive, were removed. On November 12, 1928 the lower stage was performed removing 63 cm. of the ribs from the seventh to the eleventh inclusive. She made a very good recovery and returned to the sanatorium from which she came.

Although a reasonably good collapse of the chest was obtained in this case and the patient improved generally, she did not entirely lose the productive cough. An *x*-ray examination showed that there still remained uncollapsed cavities in the upper lobe. Therefore, on May 16, 1929, through an incision beginning over the upper part of the anterior axillary fold and

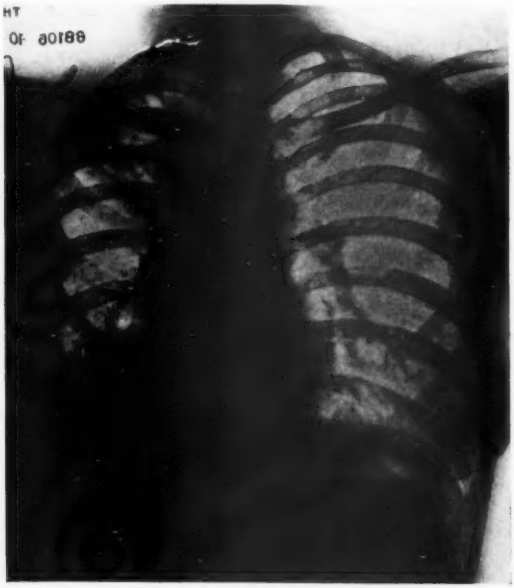


Fig. 442.—Case I. Chronic pulmonary tuberculosis with cavity formation in the right upper lobe, displacement of mediastinal structures and elevation of diaphragm.

running downward into the axilla I resected an additional $10\frac{1}{2}$ cm. of the fourth, 10 cm. of the third, $8\frac{1}{2}$ cm. of the second, 10 cm. of the fifth, and $3\frac{1}{4}$ cm. of the first rib in the order named. As far as I could tell, at operation, the ribs were taken out from the point of previous section to the costochondral junction. I was surprised at the ease with which the first rib was resected through this incision.

This patient in the six weeks which have elapsed since her last operation has shown marked improvement. The expectoration has diminished and she has been afebrile at least part of the time (Fig. 443).

I regret that we did not do the anterior operation before regeneration of the ribs, previously resected, had taken place. Removal

Fig. 443.—Case I. Showing collapse after thoracoplasty.

of the re-formed posterior rib-ends, however, will be undertaken and further collapse obtained if such seems to be indicated.

A total of 157 cm. of ribs were removed in this case.

E. S. Welles[1] of Saranac has called attention to the impor-

[1] Welles, E. S.: Accessory Thoracoplastic Operation for Collapse of Large Tuberculous Cavities. Archives of Surgery, vol. 14, no. 1, pt. 2, p. 384, January, 1927.

tance of additional anterior thoracoplastic procedures for collapse of large tuberculous cavities, and I am convinced that such a procedure should be resorted to early, and planned from the first in those cases which have large upper lobe cavities.

Case II.—A white woman, age thirty-five years, had pulmonary tuberculosis complicated by a tuberculous empyema necessitatis. On her admission to the hospital she had a swelling about the size of an adult fist (Fig. 444) over the lower ribs, a little in front of the posterior axillary line. This could be reduced somewhat by exerting pressure over it and gave an impulse upon coughing. Prior to operation she had a number of aspirations (Fig. 445)

Fig. 444.—Case II. Chronic pulmonary tuberculosis and tuberculous empyema necessitatis. Showing the cold abscess in the chest wall.

and the fluid removed was thick and greenish-yellow in color. Upon guinea-pig inoculation, tubercle bacilli were recovered. On May 18, 1927 I did a paravertebral extrapleural thoracoplasty, performing the upper stage first. Preliminary to operation the pleural cavity was emptied as completely as possible, replacing fluid with air and pressure made over the cold abscess of the chest wall. On June 2, 1927 the second stage was performed taking out long sections of the lower ribs. Just before starting the operation the pleural cavity was emptied of about 250 c.c. of fluid, a little lighter in color and consistency than that which was previously removed. The usual hook incision of Sauerbruch was used. In resecting the eleventh rib the old abscess cavity

in the chest wall was opened. It was now about the size of a lemon and contained gelatinous material. It apparently no longer communicated with the pleural cavity. It was wiped out with gauze, swabbed with iodin, and obliterated with a few sutures of chromic gut. The muscles and skin were closed in the usual manner and the patient made a good recovery.

At the present time she is entirely free of symptoms and is able to do practically all of her housework. She has not required aspiration since her last operation. *x*-Ray examination shows no evidence of fluid and as you see, her general appearance is excellent (Figs. 446, 447).

Fig. 445.—Case II. Film made after aspiration of fluid and replacement with air. The outline of the cold abscess filled with air is well shown.

In these operations surgeons are coming more and more to use general anesthesia in conjunction with local anesthesia. It has been our practice to expose the ribs under local infiltration anesthesia, and to distend the interspaces at a point close to the spine with the anesthetic fluid. Nitrous oxid is administered while the ribs are being resected. With light general anesthesia the operation can be done more rapidly, less novocain is used, there is less shock, and both patient and surgeon are more com-

fortable. In order to obtain a good collapse it is necessary to resect the ribs close to the spine, to remove a portion of the first rib, or at least to divide it, and to complete the whole operation before regeneration of the ribs removed at the preceding stage has taken place. The best collapse is obtained if the entire operation is completed in a single stage, but the one-stage operation gives a higher mortality and for that reason we prefer a two- or even a three-stage procedure. The cases which offer the best

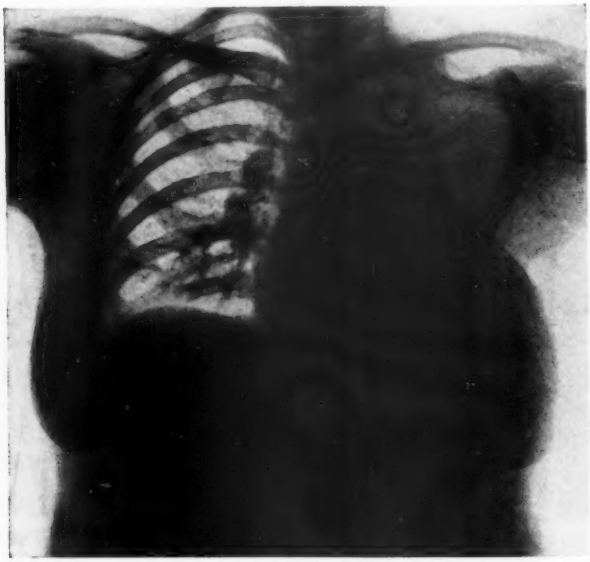


Fig. 446.—Case II. Film made after a paravertebral extrapleural thoracoplasty.

prospect for cure are those which have proved their resistance to the disease as expressed by chronicity and by fibrosis of the lung. Many of them show displacement of the mediastinal structures to the affected side, elevation of the diaphragm, and contraction of the chest wall. Here nature has already pointed out the way and the surgical procedure only facilitates further contraction and brings about rest. Thoracoplasty not only produces col-

lapse but also fixation of the chest wall through fusion of the regenerated ribs and consequently rest on the affected side. The lesions must be chiefly unilateral. Some disease in the opposite

Fig. 447.—Case II. Photograph of the patient after operation showing the final result.

lung nearly always exists and does not contraindicate operation provided it is slight and chronic, but active and progressive disease in the good lung is an absolute contraindication.

CHRONIC PULMONARY ABSCESS TREATED BY EXTERNAL OPERATION

I wish to present this case and emphasize a few points which we believe are of importance in the surgical treatment of pulmonary abscess.

Case III.—A white man, age forty years, developed an abscess in the right middle lobe in February, 1928. He gave no history of foreign body, previous surgical operation or pneumonia, and apparently belongs to the group of cases which begin as an acute respiratory infection, at first seemingly trivial, but which eventuate in a pulmonary abscess. The abscess was localized in the right middle lobe by clinical, roentgenographic, and bronchoscopic ex-

aminations. Prior to operation he was in poor physical condition. He had lost a great deal of weight, was running a low-grade fever, and expectorated about 14 ounces of mucopus per day which had a very foul odor. He was treated by conservative measures including bronchoscopic drainage and there was some improvement in his general condition. On January 7, 1929 he was operated upon under infiltration anesthesia. The abscess was exposed by resecting 8 or 10 cm. of the third and fourth ribs from close to the costochondral junction outward and, in addition, the periosteum of the third rib was excised. The wound was then loosely packed with vaseline gauze. Subsequently the abscess, which was not a very large one, was practically excised in stages. At the first stage the outer wall was removed with the endotherm knife, and at the second stage the remaining wall was taken away. There was remarkably little bleeding except from the vessels which accompanied the small bronchi and these required ligatures. This patient rapidly lost his cough and expectoration and is now back to his normal weight. The wound, now five months after the first operation, is almost healed and the patient has been able to return to work. He has no cough or expectoration.

With increasing experience our views regarding the proper procedure in the surgical treatment of pulmonary abscess have undergone some changes. We are no longer content with simple drainage in the majority of cases, but believe that something more must be done if a complete cure is to be obtained. Points which we regard as of the first importance are wide exposure of the abscess, operation in stages, and removal, if possible, of at least a large part of the outer wall of the abscess cavity. With wide exposure, hemorrhage, should it occur, can be more easily controlled, and removal of the rigid framework of the chest over the abscess cavity greatly facilitates contraction of its walls. We have discontinued the use of drainage tubes except when we wish to establish a permanent fistula. We pack the cavity with gauze which, while it permits drainage, obstructs the opening sufficiently to enable the patient to cough effectively and bring up material from parts of the lung not drained through the abscess cavity. This, we believe, lessens the occurrence of pulmonary complications which sometimes closely follow external drainage of a large abscess. We attempt to remove or destroy the abscess wall with the endotherm knife, with the electric cautery, or with the soldering iron after the method of Graham.[1]

[1] Graham, E. A.: Rôle of Surgery in Treatment of Pulmonary Suppuration. J. A. M. A., 85, 181, July 18, 1925.

CHRONIC EMPYEMA

Case IV.—This patient, a white girl, age seventeen years, gave a history of having been operated upon for an acute empyema following pneumonia six years ago. A sinus persisted after this operation and she never regained her former health. A short time prior to her admission to the hospital the left breast became greatly swollen and tender. She was running a high fever and appeared quite ill. On October 30, 1928 she was operated upon and a huge abscess beneath the breast, which communicated with the old empyema cavity, was opened. Nine days later two ribs were removed and the empyema cavity

Fig. 448.—Case IV. Chronic empyema. Film showing the final result after decortication and a plastic operation on the chest wall.

was drained. It had dense walls and contained a large amount of thick, yellow pus. Carrel-Dakin treatment was carried out with marked improvement in the patient's general condition and diminution in the size of the empyema cavity.

On March 4, 1929 under nitrous oxid anesthesia the old sinus was completely excised, and the incision carried upward and backward between the scapula and the spine. Long sections of the eighth, seventh, sixth, and fifth ribs were removed. I was surprised to find how much the empyema cavity had diminished in size. The pleura was enormously thickened. The thick-

ened visceral pleura was excised with the endotherm knife so that expansion of the lung might be utilized in helping to obliterate the old cavity. The muscles were closed with sutures of chromic gut and the skin wound partly closed leaving in place a vaseline gauze pack. The patient made an uneventful recovery and the wound has been solidly healed for several months (Fig. 448).

I am showing this case chiefly because the endotherm knife was used with great satisfaction in excising the thickened pleura.

CLINIC OF DR. ASTLEY P. C. ASHHURST

EDWARD T. CROSSAN, M. D., ASSOCIATE SURGEON

EPISCOPAL HOSPITAL

UNUSUAL TUMORS OF THE SOFT PARTS

IN this presentation I am using the term "unusual" to indicate tumors that are uncommon though not rare. Because these tumors are uncommon they afford problems in diagnosis and prognosis, and it is from this viewpoint chiefly that I intend to discuss these cases.

CASE I. ABDOMINAL TUMOR

Julia B., Austrian, age forty-three years, a housewife by occupation. Admitted 4/24/29. Discharged 5/23/29.

Family History.—Husband and three children living and well. Two children died in early childhood, and the last two children born dead at term.

Previous Medical History.—Not noteworthy.

History of Present Illness.—Chief complaint: Abdominal tumor.

About three months after the birth of her last child (three years ago) the patient noticed a hard, painless lump in the right hypochondrium; the mass gradually increased in size. Two years after the onset she was operated on in another hospital in this city. Two weeks after the operation, and as soon as the removal of the dressings permitted palpation of the abdomen, the patient noticed that the tumor was still present, and had not decreased in size. Since the operation the mass has continued to grow.

She has never had any pain, any jaundice, or any digestive disturbances.

Examination on Admission.—Fairly obese adult female, apparently not uncomfortable.

Scalp negative.

Ears negative.

Eyes: Pupils equal, react normally to light and accommodation. No extra-ocular palsies.

Mouth: Teeth and gums excellent. One or two small ulcerations on the buccal mucous membrane. Right tonsil hypertrophic and cryptic.

Neck negative.

Thorax: Expansion slight, but equal on both sides. Percussion note is resonant throughout. Vocal resonance and tactile fremitus diminished in

right axilla, otherwise normal. The breath sounds are harsh and have a wheezing quality at the base. Heart normal.

Breasts are pendulous. No masses. Scar on right breast, the result of a scald.

Abdomen: Very obese and sagging in the flanks. Over the upper third of the right rectus there is a longitudinal scar 8 cm. long, the result of the previous operation; moderate keloid formation in the scar.

In the upper half of the right rectus there is a hard, nodular, painless, irregularly circular mass extending from the costal border downward almost to the umbilicus and crosswise from linea alba outward 15 cm. It does not move with respiration except as the abdominal wall moves. It moves freely from side to side with the abdominal wall. The mass is not attached to the skin.

Laboratory Examination.—White blood-cells 5000.

Urine: Light amber, acid, 1.035, slight trace of albumin, no sugar, no casts, no erythrocytes, no leukocytes.

Wassermann negative.

Diagnosis.—Here is a woman, forty-three years of age, with a painless abdominal tumor occupying nearly the entire upper right quadrant of the abdominal wall which had started as a small lump after childbirth, had been growing for three years before admission, had been operated on at another hospital one year before admission, and which, as far as we could ascertain, had not metastasized.

What was done at the other hospital? Communication with this hospital disclosed the fact that they had no record of the patient. That she had been operated on was clearly shown by the upper right rectus scar. From the fact that the patient still felt the tumor when the dressings were removed, I believe that an exploratory operation or a biopsy was done. At any rate, there is sufficient data in this history and examination to make an accurate diagnosis.

Now, it is probable that the mass is not intra-abdominal, because a mass as large as this within the abdomen would certainly have obstructed the gastro-intestinal canal or the biliary drainage apparatus. Also, if this tumor was in the abdominal wall it must be benign for the reason that there has not been any metastasis in three years. Since it is benign and does not involve the skin it must be a fibroma. Fibromas in the abdominal wall of women occurring after childbirth are known as desmoids.

Operation.—Three days after admission (4/27/29). Sur-

geon, Dr. Ashhurst. Anesthetic, ether. Incision 30 cm. long in right hypogastrium encircling the mass. The mass was adherent to the peritoneum, but did not penetrate the membrane. The entire mass with the peritoneum, the overlying skin, and the scar was excised. The defect involved the rectus muscle and the

Fig. 449.—Desmoid, split open at right angles to overlying skin to show its fibrous center.

Fig. 450.—Tumor has been split open, showing in this view the peritoneum.

oblique muscles from the costal border to the umbilicus. A flap of fascia lata 10 x 19 cm., which was excised from the right thigh, was used to close the gap; the flap was sutured on one side to the transversalis fascia and on the other to the posterior sheath of the rectus by interrupted No. 2 chromic gut sutures, and the gap was closed without much tension. The abdominal

muscular gap was closed by flexing the hips and bringing the chin down to the knees while suturing the muscles by interrupted mattress No. 2 chromic. Skin and fat closed by interrupted silkworm gut. Figures 449 and 450 show gross specimen removed.

On sectioning the mass across it was found that the cut surface was made up of numerous cross striations which are rather typical of desmoids.

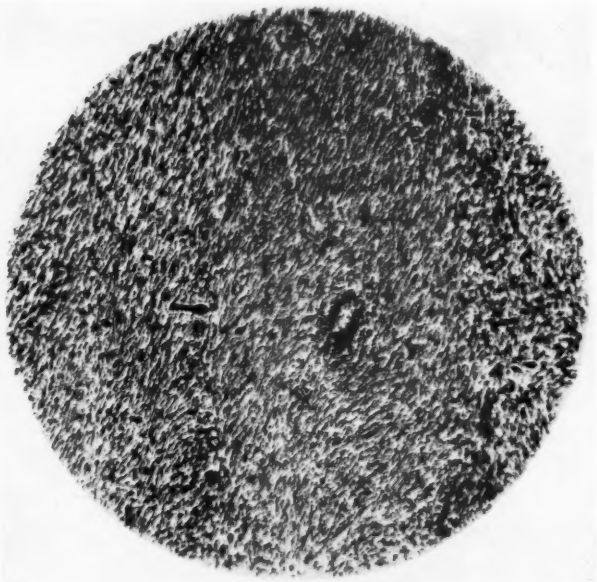


Fig. 451.—Photomicrograph of section from desmoid, showing cellular fibrous tissue.

Pathologic Report (Dr. C. Y. White).—Fibroma of the abdominal wall (Fig. 451).

Progress.—The patient made an uneventful recovery.

Discussion.—Desmoid is a term that was first used by J. Müller to designate tumors of tendon-like consistency. In 1884 Sanger appropriated this name to those tumors of the abdominal wall which occur in women, usually in women who have borne

children. In this particular case the onset was three months after childbirth.

Labbé and Remy believe that during pregnancy or childbirth there is a rupture of some of the rectus fibers, and from this traumatized area the new growth arises, and to this view Pfeiffer subscribes. Sanger is of the opinion that the tumor springs from the rectus sheath. Whichever view is correct, it is certain that the mass springs from the region of the rectus muscle, and not from bone as was at first believed. Histologically the tumor is made up of soft or hard fibrous tissue, with occasional cases showing interlacing bundles like a neurofibroma. The section from the tumor here reported, and as shown in Figure 451, is a cellular variety of the fibroma. That these tumors are essentially benign is confirmed by all the reporters, though there is an occasional report of recurrence, probably due to incomplete removal.

The tumor does not occasion any symptoms other than the presence of the mass: it is not tender, nor does it occasion any pain. The fact that the mass is immobile when the abdominal muscles contract is given as an aid in the diagnosis. The diagnosis is usually made from the history, once the tumor has been localized in the parietes.

One word about treatment. Excision of the tumor with a plastic repair of the defect is still the accepted method. Radium and electrolysis have their advocates, and for these methods it is claimed that there is less likelihood of recurrence, a view with which Stewart and Mouat do not concur.

CASE II. TUMOR OF THE BREAST

Martha R., white, female, forty-one years of age, housewife by occupation. Admitted 5/9/27. Discharged 5/29/27.

Family History.—Not noteworthy.

Previous Medical History.—Menstrual history normal until July, 1926 when a panhysterectomy was done in this hospital for a prolapse of the uterus. In 1922 she had (done at another hospital) a perineal repair for the prolapse, but without any relief. In December, 1921 she had a cholecystectomy performed in this hospital.

History of Present Illness.—Chief complaint: Swelling in both breasts. After the panhysterectomy the patient was ordered hypodermoclysis to

combat the shock. By mistake the patient was given the salt solution into the mammary glands. The next day after operation the breasts became tremendously swollen, and on the left breast she developed a small area of gangrenous skin. As soon as the inflammation of the breasts subsided the patient noticed lumps in both breasts. The lumps have not increased in size and have not caused any pain.

Examination.—Generally negative except for the scars of the previous abdominal operation and for the condition of the mammary glands.

Fig. 452.—Left mammary gland. Lump resulting from fat necrosis in left breast.

Breasts: Both very fat and pendulous.

Right Breast: Mass 5 cm. in diameter above and lateral to the nipple. Mass hard, irregular, very firm and adherent to the chest wall. No axillary enlargement.

Left Breast: Mass 7 or 8 cm. in diameter in the lower outer quadrant. This mass was also irregular and very hard, and adherent to the chest wall. No axillary enlargement.

Diagnosis.—Having in mind Lee and Adair's communication in the Annals of Surgery of 1924, and since there was a clear history of trauma, we felt that this patient had traumatic fat necrosis of the breast.

Operation 5/11/27.—Surgeon: Dr. Crossan. Anesthetic: ether.

Elliptical incision from midpoint of the sternum to the anterior axillary line, encircling the nipple and excising a bridge of skin 8 cm. wide at the nipple. The gland was found to be densely adherent to the pectoral fascia. The gland removed en masse. Fat approximated by interrupted 00 chromic. Skin closed by interrupted silkworm gut. Rubber dam drainage at the outer angle.

Progress.—The convalescence was uneventful. Discharged on May 29th.

End-result.—When seen in the clinic one year later there was no recurrence. The tumor in the right breast had not increased in size and did not cause pain, therefore she does not wish to submit to another operation.

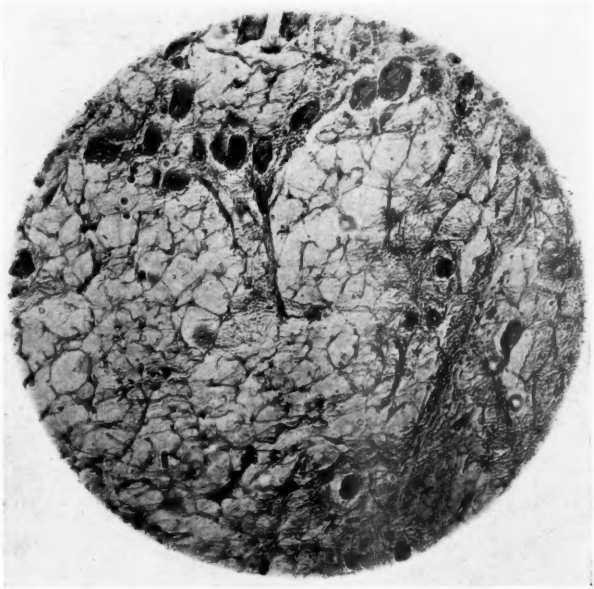


Fig. 453.—Section from Martha R., fat necrosis breast.

Discussion.—Since the mass in the left breast was the larger, we decided on the first operation for this side. Because the breast was pendulous and because we were not positive of the diagnosis of fat necrosis it was decided to do a breast amputation. Section of the excised tissue showed a concentric area of fat lighter in color than the surrounding tissue, enclosed and sharply defined from the rest of the gland by a firm capsule (Fig. 452).

Histologic report (Dr. C. Y. White): Fibrofatty tissue with areas of fibrous bands—the results of an inflammatory process because they contain numerous small blood-vessels (Fig. 453).

Traumatic fat necrosis of the breast was first brought to the attention of the surgical profession by Lee and Adair in 1920. Subsequently, in 1924, they published another paper reporting 15 cases. These authors called attention to the fact that this condition could be (and probably had been) mistaken for carcinoma.

Most of the cases reported give a history of trauma to the breast with an appearance of a lump shortly after the injury. Some of the cases, like the one here reported, were the results of improperly administered hypodermoclysis. According to Lee and Adair there is a necrosis of the tissue and a disintegration of the fat which is followed in a few weeks by the appearance of giant-cells, and later by an obliterating endarteritis, by the formation of cysts, of fibrous tissue, and of a laminated fibrous wall.

On examination there is found an irregular stony hard mass; the firmness is due to the fibrous tissue. The mass is attached in many cases to the skin. In some of the cases there is a retraction of the nipple. In differentiating the condition from carcinoma, great reliance is placed on the appearance of the mass soon after trauma and, also, on the absence of axillary gland involvement.

Gross section shows the encapsulated fat or cysts. There are none of the chalky points, or the streaks of fatty epithelium as seen in carcinoma on naked eye inspection. Microscopically there are seen cellular overgrowth, fibroblasts, lymphocytes, empty spaces once filled with fat, areas of proliferating fat cells, and phagocytic giant-cells (Ewing). No giant-cells were seen in the section from the case here reported.

Treatment is excision of the mass—amputation of the breast is not necessary.

CASE III. TUMOR OF THIGH

Anthony V., age thirty-two years, Austrian, laborer by occupation. Admitted 5/23/29. Discharged 5/24/29.

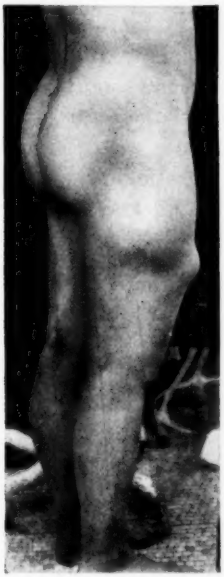
Family History.—Negative.

Personal History.—Negative.

Previous Medical History.—Negative.

History of Present Illness.—In 1921 was knocked down and a wagon wheel passed over his right thigh. The thigh became swollen in a few days and the swelling never disappeared. The mass has never been painful.

About four months before admission he fell and struck the mass. Shortly after the accident he noticed a small tumor at the lower end of the swelling. This has progressively increased in size. Never had any pain.



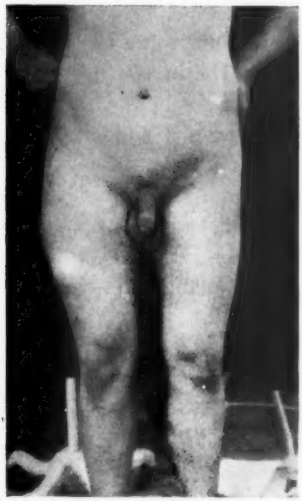


Fig. 454.—Injury eight years ago, resulting with tumor ever since. Sudden growth during last four months. Sarcoma of right thigh, amputation refused.

Examination.—Well-nourished male, scalp, eyes, ears, and throat negative.

Neck: No adenopathy.

Chest: Normal in shape. Heart and lungs negative.

Abdomen: No masses, no tenderness, no rigidity, and no hernia.

Extremities: On the posterolateral aspect of the right thigh at the junction of the upper and middle thirds there is a firm smooth mass about the size of an adult male hand. Continuous with the latter, and on the anterior surface of the thigh, there is a rounded mass about the size of a hen's egg (Fig. 454). Skin moves over the masses to some extent. Neither mass is firmly attached. No inguinal adenopathy.

Laboratory Examination: Urine acid, specific gravity 1.022, faint trace of albumin, negative for sugar, leukocytes, erythrocytes, and casts.

x-Ray Examination: Dr. Bromer 5/23/29, No. 56550.

Chest: Shows marked density in each hilium with exaggeration of trunk, shadows evidently due to a chronic infection.

Diagnosis.—It is very probable that this patient had a sarcoma. It is also probable that this tumor was not associated with the bone because the tumor was over the middle of the shaft of the femur, whereas sarcoma of bones usually occurs at the diaphyses. Nor was it a Ewing's tumor—endothelioma of bone—because there is not a concentric enlargement of the extremity. The interesting point in this case is the presence of a quiescent mass in the thigh for eight years following a severe accident, with a sudden and progressive growth of the mass following a comparatively trivial injury to this area. What is the explanation? Probably, that as a result of the first accident the patient had an organized hematoma or even a giant-cell tumor of the fascia which, from repeated irritation, or as a result of the fall, changed its character to a sarcoma. Patient refused an amputation.

CASE IV. SPINDLE-CELL SARCOMA OF MUSCLES OF THIGH

Clarence K., white, thirty years of age, roofer by occupation. Admitted 11/23/25. Discharged 12/12/25.

Family History.—Father, mother, sister, wife, and one child living and well.

Personal History.—Negative.

Previous Medical History.—Denies venereal history. Other than an attack of typhoid fever in childhood, he has never been ill. No operations or injuries.

History of Present Illness.—Chief complaint, tumor of left thigh.

Seven months before admission the patient noticed a lump on the left thigh about the size of a dime. In a month the tumor increased to about the size of a walnut. For a month preceding admission the tumor had been growing rapidly. The tumor was never painful and always freely movable. The patient first consulted a physician in August, 1926 (three months before admission) and was told that the mass was a fatty tumor.

The patient thought the tumor might be due to some bruise or that it was due to rolls of roofing paper striking nails in his pocket while he was at work as a roofer.

Physical Examination.—A fairly well-nourished male. No dyspnea, cyanosis, anemia, or edema.

Head negative.

Eyes: Pupils equal, regular, react normally. No extra-ocular palsies.

Mouth negative.

Neck: No abnormal pulsations. No adenopathy.

Chest: Angle of Louis prominent. Expansion good and equal. Lungs negative. Heart showed a presystolic murmur and a systolic shock.

Abdomen: No masses or areas of tenderness.

Extremities: Left lower—In the middle third of the anterior surface of the thigh there is a mass measuring 12 x 10 cm. and extending 6 cm. above the

Fig. 455.—Sarcoma of left thigh, seven months, rapid growth one month. Cystic spindle cell.

surface of the thigh (Fig. 455). The mass is globular in outline, firm consistency, and movable. It is attached to the soft parts, but not to the skin. The mass is not hot, and there are no distended veins over it.

Reflexes are present and normal.

Laboratory Examination:

Blood, red blood-cells 3,480,000; white blood-cells 12,000; hemoglobin 60 per cent.; differential blood-count: polynuclears 74 per cent., mononuclears 4 per cent., transitional cells 3 per cent., lymphocytes 19 per cent.

Urine: Reaction acid, specific gravity 1.025, albumin negative, sugar negative, epithelial cells many, no pus cells, no erythrocytes, and no casts.

x-Ray of chest 11/23/26, No. 38250 (Dr. Bromer): There is peribronchial and hilum infiltration in both lungs extending well out to the periphery causing marked accentuation of the linear markings of the lung fields. The infiltration extends well into the apices. There is undoubtedly a disseminated process due to either metastatic tumors or a chronic infection.

Operation.—Dr. Ashhurst, 11/24/26. Anesthetic: Ether. Excision of tumor of thigh. Esmarch band applied over Wyeth pins with a pad over femoral artery.

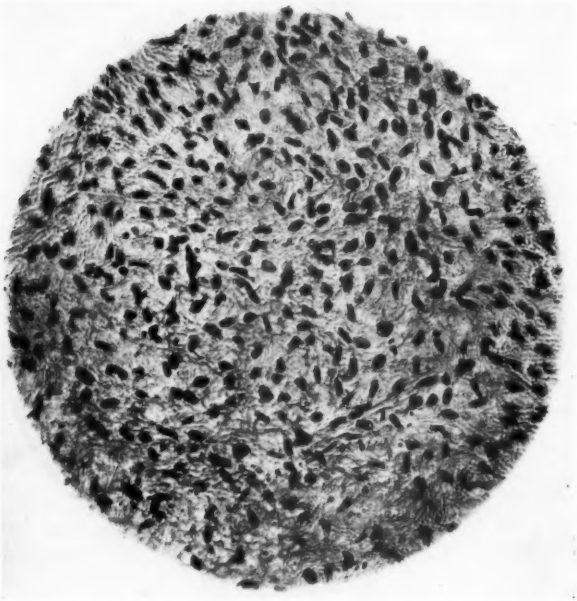


Fig. 456.—High-power field showing numerous young spindle cells.

Incision from below hip to just above patella encircling tumor and leaving a bridge of skin 10 cm. wide and 25 cm. long attached to tumor. Femoral vessels and anterior crural nerve exposed above and median to tumor. The tumor was found to involve the rectus muscles and the vasti muscles. The tumor was excised en masse by scalpel; no malignant tissue seen at any time. Bleeding points ligated after removal of tourniquet. The proximal stumps of the sartorius and the rectus femoris were drawn across and over the femoral vessels and sutured to the adductors. The stumps of the vasti sutured together and anchored to the distal stump of the rectus femoris. Skin closed by

interrupted silkworm gut. Iodoform gauze drain at upper angle of the incision. Time, fifty-five minutes.

Progress:

11/26/26, Gauze drain removed.

11/30/26, Some serous oozing from site of drain.

12/7/26, All sutures removed. Wound clean.

12/11/26, Unable to actively flex thigh and is unable to bear weight on the left lower extremity.

Discharged 12/15/26.

Histologic report (Dr. C. Y. White): Spindle-cell sarcoma (Fig. 456.)

End-result: Recurrence noted in upper end of scar on 4/29/27 (Fig. 457). Unable to hold knee extended against gravity. Died September, 1927.

Fig. 457.—Recurrent sarcoma. Walks well, leg-over-leg upstairs until tired, but cannot hold knee extended against gravity.

CASE V. RHABDOMYOMA OF THE MUSCLES OF THE LEG

Evelyn C., female, colored, age two and a half years, admitted 2/23/26. Discharged 7/2/26.

Family History.—Father, mother, and one other child living and well. Mother never had any miscarriages.

Previous Medical History.—"Running ear" for one year.

History of Present Illness.—As the child was standing on a chair on or about December 10, the right foot slipped causing the child to scream and complain of pain. On the morning following the accident the left leg was swollen. For the week following the accident the child walked about as usual

but at the end of that time she began to walk on her toes. For a month previous to coming to the hospital the child has not walked. There has been no complaint of pain since the day of the accident; no night cries. Swelling has increased about twice the size since the onset.

Examination.—Walks on toes, foot in varus, and knee flexed. Visible spindle-shaped swelling affecting median surface of the calf from knee almost to internal malleolus. Dorsiflexion of ankle limited at 115 degrees even with the knee flexed. Circumference of right calf 16 cm.; of left calf over tumor

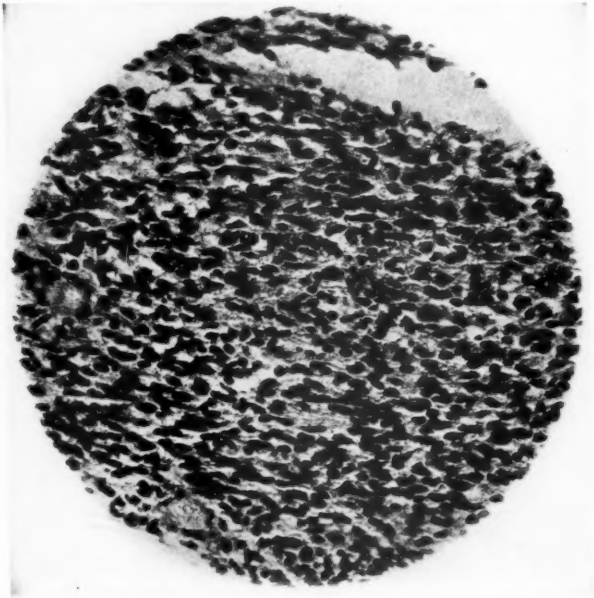


Fig. 458.—Photomicrograph from section removed at operation of Evelyn C. on March 24, 1926. Shows numerous round cells, also some distinctly spindle cells.

20 cm. Swelling is firm, elastic, semicystic in places and not tender. Enlarged lymph-nodes in left groin. The tumor moves slightly in the bone.

Laboratory Examination.—*x*-Ray (Dr. R. S. Bromer) No. 12293. No bone involvement.

Urine negative.

Blood: Red blood-cells 4,100,000; white blood-cells 10,400; hemoglobin 101; polynuclear 30 per cent.; mononuclears 9 per cent.; transitionals 5 per cent.; lymphocytes 54 per cent.; eosinophils 1 per cent.

Operation 3/4/26.—Surgeon, Dr. Ashhurst. Anesthetic, ether. Excision

of tumor. Esmarch band above knee. Incision from below popliteal space to insertion of tendo achillis. Gastrocnemius was found spread out over upper half of tumor; detached. Tumor was found to involve soleus muscle. Tumor removed exposing posterior tibial vessel from end to end of wound. Deep fascia closed by interrupted chromic No. 1. Skin closed by lock stitch chromic 00. Plaster paris from toes to midthigh.

Histologic Report.—Round-cell sarcoma (Fig. 458).

Fig. 459.—High-power field of section from tumor of Evelyn C. Case V. In center of field is seen a giant-cell, numerous spindle-shaped muscle cells. Also cross-sections of muscle cells are shown. All the cells were strongly acidophil.

Progress.—Was detained in hospital till July 2d. Was given Coley's fluid once a week; started on $\frac{1}{10}$ minim and increased gradually to 2 minims. *x*-Ray examination of lungs on 4/8/26 (No. 12450) peribronchial and hilum infiltration, due either to tuberculosis or to sarcoma. *x*-Ray 5/4/26 (No. 12559) showed hilum density and discrete nodular shadows on the right.

On 9/14/26, at the point where the muscle fibers join the tendo achillis, there was noticed a fusiform swelling about 5 cm. in greatest measurement. Readmitted.

History on Second Admission.—Readmission on September 22, 1926, discharged December 17, 1926.

The patient had had no symptoms or disability since the previous discharge. Readmitted on account of mass noted on 9/14/26.

Laboratory.—Urine negative.

Blood: Hemoglobin 63 per cent.; red blood-cells 4,270,000; white blood-cells 9800; polynuclears 62 per cent.; mononuclears 7 per cent.; transitionals 2 per cent.; lymphocytes 29 per cent. Amputation was advised, but refused.

Operation.—September 23, 1926. Surgeon, Dr. Ashhurst. Anesthetic, ether. Excision of recurrent tumor. Esmarch band above knee. Incision

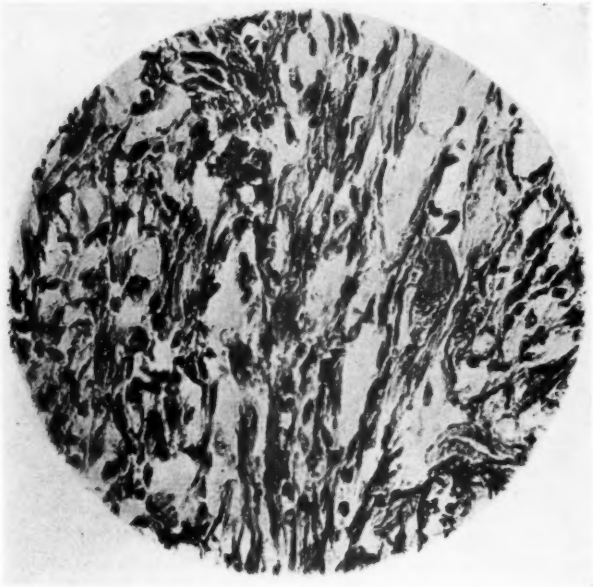


Fig. 460.—Case V, Evelyn C. In this section there are seen numerous elongated spindle cells which are young muscle cells. Many of the cells showed mitotic figures.

from os calcis to internal condyle of femur reflecting skin and fat. A recurrent white fibrous tumor was found below middle of calf invading remains of gastrocnemius, and involving the posterior tibial vessels and the muscles of the interosseous space. Long and short saphenous veins tied above and below the tumor, as were the posterior tibial artery and vein. The posterior tibial nerve was dissected free from the mass. The mass and all of the muscles of the posterior aspect of the leg were excised. Excess of skin cut away. Skin closed with chromic. Posterior splint.

Histologic Report.—Tissue similar to that removed on 3/4/26.

Progress.—The wound healed by primary intention. Two weeks after operation, Coley's fluid in mxss. doses was started; the "serum" was given every four days in gradually increasing doses until at the time of discharge the patient was receiving 5 mx. Discharged 12/17/26, without signs of recurrence.

Subsequent History.—A few months after the last discharge another recurrent tumor was noted in the calf of the leg. For this recurrence, the leg was amputated at another hospital in this city.

Discussion.—On reviewing the slide from the second operation I found numerous non-striated muscle fibers, which were strongly acidophil, some giant-cells, some mitotic figures; no cross striation seen (Figs. 459 and 460). In the field were numerous acidophil round cells which were cross-sections of muscle cells, and numerous dark staining cells as seen in Fig. 458 (from the first operation), the latter are probably myoblasts. The histologic picture, it seems to me, is that of a rhabdomyoma.

PRIMARY MALIGNANT SKELETAL MUSCLE TUMORS

The malignant muscle tumors are of two varieties, viz.: (1) sarcoma and (2) rhabdomyoma.

The sarcoma springs from the endomysium or the perimysium. Histologically, these tumors are either a fibrosarcoma or a myxosarcoma with large or small cells. It is possible that round-cell sarcoma of muscles could occur from myoblasts or misplaced bone-forming elements. This variety is supposed to occur at the tendinous insertions.

Rhabdomyoma of skeletal muscles is one of the rarest tumors reported. Wollbach, in the Archives of Pathology and Laboratory Medicine of June, 1928, makes note that up until that time there were not more than 28 cases which were authentic and of these, there was some doubt about 5 of the cases really belonging to this group. Rhabdomyomas are more common in the kidney and testicles, also, though much less frequently, they have been reported as occurring in the heart, esophagus, tongue, parotid gland, and breast. Histologically, the tumor is made up of parallel bundles or intertwining strands of striped muscle fibers. The cells assume a spindle shape, show one or more nuclei, and are usually acidophil. The nuclei in most of the cells are situ-

ated in the center, the characteristic position in the young muscle cells. Many mitotic figures are seen. Cross striations are absent in most of the cells, probably because the characteristic striation appears in the late stages of the muscle cell development.

CASE VI. MULTIPLE TUMORS OF THE NECK, FACE, AND TRUNK

William J. M., age thirty-seven years, motorman by occupation. Admitted 1/10/25. Died 2/10/25.

Family History.—Mother died of milk-leg. Father died of complication of diseases. One sister died of tuberculosis. One brother and two sisters living and well. Is married and has four healthy children. Wife is nearly at term with fifth pregnancy.

Fig. 461.—Neurocytoma, metastatic.

Fig. 462.—Same patient as Fig. 461.

Previous Medical History.—Measles, mumps, chickenpox, and whooping-cough. Has had occasional attacks of sore throat, and is subject to colds. Denies venereal infection. Tumor removed from left side of face three years previous to this admission. Two years ago was threatened with tuberculosis.

History of Present Illness.—Chief complaint, multiple painful swellings. About six months before admission, noticed a small lump on the right forearm which was red and tender, and which he thought was a boil, however it did not break down and disappeared in about six weeks. This was followed shortly after by another lump on the same forearm which did not disappear

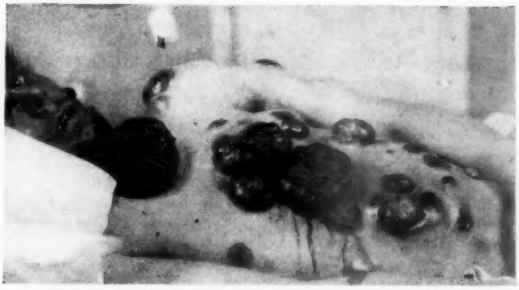


Fig. 463.—Case VI. Sarcomatosis, duration seven months.

and which was followed by many lumps over various parts of the body. For the past few weeks lumps have been growing rapidly.

Examination.—Anemic looking male whose face, trunk, and upper extremities are covered by numerous nodules (Figs. 461–464), varying in size from an egg to an orange. The nodules are of a bluish tinge, semisolid consistency, fixed to the underlying tissues, and are tender.

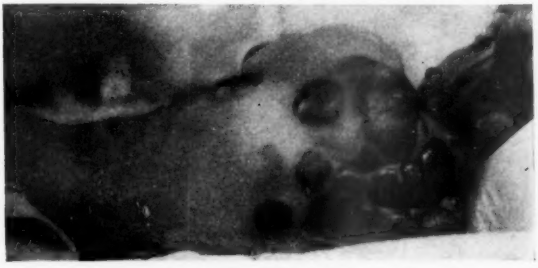


Fig. 464.—A few days before death.

Mouth: Teeth in poor condition.

Chest: Heart and lungs could not be examined on account of nodules.

Progress:

1/21/25, Unable to sleep on account of nodules. Nodules are ulcerating and breaking down. Biopsy from a mass in the forearm.

1/24/25, Spat up blood-stained sputum.

1/28/25, Irrational.
2/9/25, Has a terminal pneumonia.
2/10/25, Death.

Laboratory Examination.—Urine 1.017, negative for albumin or sugar, occasional leukocytes.

Blood: White blood-cells 7200, polynuclears 80 per cent., mononuclears 2 per cent., transitionals 1 per cent., lymphocytes 16 per cent.

Discussion.—At first it was thought that this was a case of malignant degeneration of von Recklinghausen's disease. The histologic action from the specimen removed at biopsy was reported as a round-cell sarcoma (Figs. 465 and 466). Multiple

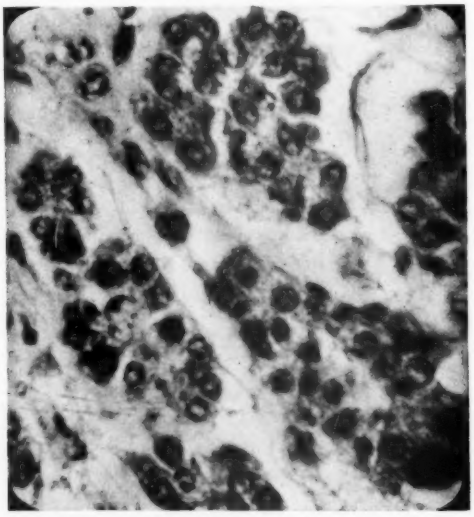


Fig. 465.—Histological section of biopsy specimen of W. M., Case VI. Shows numerous dark-staining round cells.

round-cell sarcoma is practically unknown, consequently these multiple tumors must be metastatic growths.

At the autopsy there were found the following lesions, viz.: (1) Primary tumor behind the left kidney. The mass was soft in consistency, pale gray color, measured 7 x 4 x 1 cm. and was densely adherent to the kidney capsule but did not involve the

kidney substance. (2) Metastatic nodules in stomach, pancreas, left lung, all the lymph-glands, the right tibia, and in numerous subcutaneous areas. Histologic examination of the primary growth showed normal adrenal cortex to which there was attached a tumor mass made up of numerous round cells with a tendency to rosette formation (Fig. 467) and some chromaffin cells. Histologic diagnosis was neurocytoma.

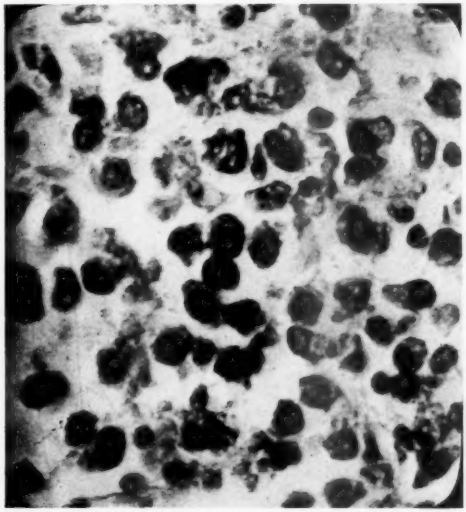


Fig. 466.—W. M., Case VI. Higher magnification of field shown in Fig. 465.

Malignant adrenal tumors are of two varieties, viz.: (1) Adenocarcinoma arising from the cortex and (2) neurocytoma from the medulla. These tumors have no relation to hypernephroma. Hypernephroma is a tumor of the kidney supposed to arise from adrenal rests.

Neurocytoma, which is also known as ganglioma, malignant sympathetic blastoma, and sympatheticoblastoma, is most frequently seen in children under three years. In children it is seen in two clinical types. In one variety, the Pepper type, there is metastases to the liver with marked enlargement of this organ.

In the second type, the Hutchinson, the growth occurs in the left adrenal with metastasis to the orbit causing exophthalmos (frequently the first symptom) and metastasis to the ribs, vertebral, and long bones.

Malignant tumors involving the left adrenal have a more widespread metastasis than those of the right. From the left adrenal the lymphatics leave the lower pole of the gland with the

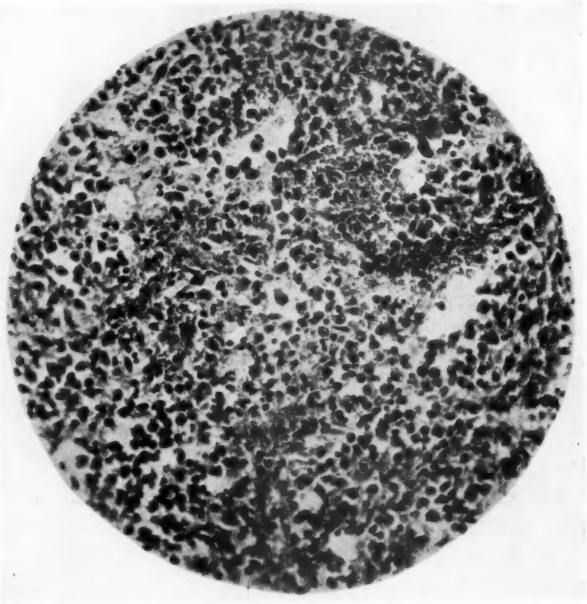


Fig. 467.—Neurocytoma. Section from adrenal tumor.

vein and join the renal vein and lymphatics thus giving to the adrenal lymphatics connections with the pelvis, the liver, the mesenteric nodes, and the deep cervical nodes. The lymphatics of the right side pass to the vena cava and from this point are limited in their passage to the liver and lungs. The widespread metastasis in the case here reported was due to the involvement of the left adrenal.

This case is not only unusual in the character of the tumor (neurocytoma) but also is of particular interest in that it occurred in an adult. In adults these tumors are said to be associated with peculiar sexual powers and unusual strength—symptoms not noted in our patient.

CASE VII. PAROTID TUMOR

John S., thirty-one years of age, dairyman by occupation. Admitted 3/21/29. Discharged 4/11/29.

Family History.—Father died of bronchopneumonia. Mother living and well. Five brothers and four sisters living and well. One sister died in confinement.

Personal History.—Had scarlet fever, diphtheria, rheumatism. Fifteen years ago had an amputation of left leg below knee as the result of a train wreck. No venereal infection.

History of Present Illness.—Fifteen years ago noticed a swelling in the left jaw. At times the mass gets much smaller. Two months ago began to experience pain in the mass, but the symptom was not accompanied by any increase in size. Figure 468 shows the mass.

Fig. 468.—Parotid tumor for fifteen years. Photographed while in bed after hernia operation and before excision of tumor.

The patient also has a left inguinal hernia which has been present for fifteen years.

Examination.—Young adult male, well nourished.

Head: Scalp, ears, nose, and eyes negative.

Mouth: Shows dental caries. Tonsils diseased. On the left jaw there was a large swelling as shown in Fig. 468. The swelling was situated at the angle of the jaw, it was hard and was about the size of an orange.

Neck: No adenopathy. Thyroid not visible or palpable.

Thorax: Well formed, expansion good, and equal. Lungs were physiologic throughout. Heart normal.

Abdomen: No masses other than the hernia.

Genitalia: In the left scrotum there was a hernia, which was easily reduced and could be held in position by pressure over the internal ring.

Extremities: Left lower missing below knee. Reflexes normal.

Laboratory Examination.—Urine acid, 1.021, negative for albumin or sugar, no casts, erythrocytes, or leukocytes.

Wassermann negative.

Blood Chemistry: Sugar 100 mg. per 100 c.c.; urea 31.7 mg. per 100 c.c.

Operation 3/23/29.—Surgeon, Dr. Ashhurst. Anesthetic, spinocain. Incision 10 cm. long over left inguinal canal exposing external ring. External oblique opened. Large sac found continuous with tunica vaginalis and very adherent to the structures of the inguinal canal. Sac opened and cut across at upper end of tunica vaginalis; opening in tunica closed by continuous chromic. Sac dissected up to expose subperitoneal fat at internal ring. Opening in parietal peritoneum at the internal ring admitted three fingers. This was closed by continuous chromic. Inguinal canal obliterated by Bassini method. Skin closed by silkworm gut.

Operation 4/3/29.—Surgeon, Dr. Ashhurst. Anesthetic, ether. Excision of mixed tumor of parotid. Incision 8 cm. long below and parallel to the angle of the jaw. Incision carried through gland tissue down to the capsule of the tumor. Tumor removed without difficulty; facial nerve or Steno's duct not injured. Dead space closed with a few buried chromic. Skin closed with equisetene.

Discharged on 4/11/29. Both wounds healed by primary intention. No facial palsy.

Discussion.—Surgeons have come to look on mixed tumors of the parotid as being particularly susceptible to sarcomatous or carcinomatous changes, consequently they are anxious to ascertain whether the tumor has undergone malignant changes, and whether it will recur. It is said that a sure clinical test of malignancy is involvement of the facial nerve.

McFarland, after a study of ninety mixed tumors of the salivary glands, reached the following conclusions, viz.: (1) That mixed tumors are due to sequestration of embryonal cells of the face and neck during development. (2) Mixed tumors are mixed tumors and nothing else, that is, they are neither endothelioma nor carcinoma. (3) Nothing of prognostic value results from the microscopic study of the tumor. (4) They are inherently benign, but commonly recur after excision and if frequently disturbed become locally destructive and invasive without producing

metastasis. (5) Malignant change in mixed tumors must be rare and its occurrence difficult to prove. (6) Intervals of ten, twenty, or thirty years may elapse between operation and recurrence.

In contradistinction to McFarland's views are those of Fry published in the British Journal of Surgery of October, 1927. The latter believes that (1) the so-called mixed tumors of the

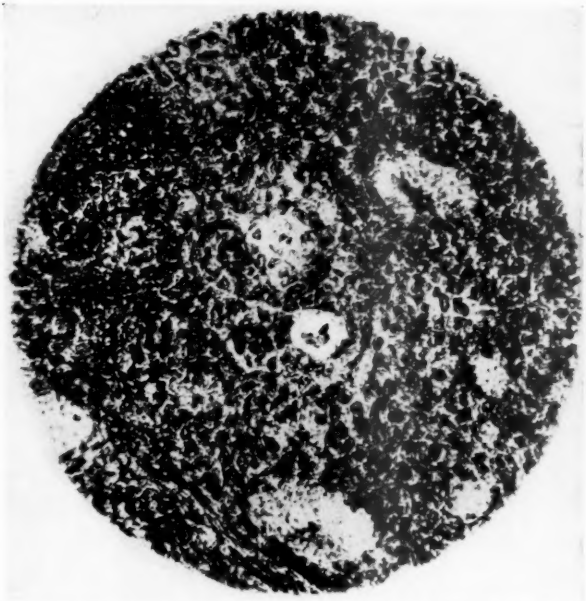


Fig. 469.—Case of parotid tumor. Shows a field of epithelial cells (not very well brought out in the photomicrograph).

salivary glands are not mixed but are epithelial in origin, derived in most cases from the ducts, occasionally from the secreting glands; (2) the mucinous material seen in these tumors is due to a secretion of mucin, and this is only an exaggeration of a normal function of the gland-cells; (3) *the tumors do not contain cartilage.* In the substance described as cartilage, the matrix is formed by a change in the mucin whereby it loses its fibrillar

appearance, and its power of staining deeply with mucicarmin and the cells are epithelial cells.

On one point Fry and McFarland agree, that is about the prognosis. On this point Fry states, "Some of the tumors show varying degrees of malignancy; there is no definite dividing line between the innocent and the malignant, and some of the

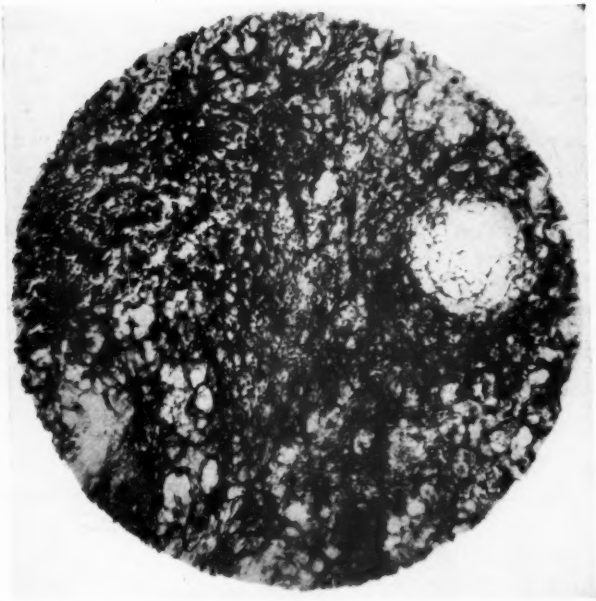


Fig. 470.—Parotid tumor, showing fibrillar mucinous material inclosing vacuoles.

more malignant may show features typical of the innocent type of tumor." It would seem that the pathologists have wrecked some of the surgeon's cherished ideas about mixed tumors of the parotid.

The histologic section in this case showed numerous epithelial cells (Fig. 469) some of which were in a flat, pavement-like arrangement. Also, there was seen a substance which under low

power looked like cartilage, but which, under high power, was seen to be made up of a fibrillar material enclosing vacuoles

Fig. 471.—Parotid tumor showing mucinous material in center of field.

(Fig. 470). Figure 471 shows mucinous material which was present in large amounts. No cartilage or bone was seen.

CONTRIBUTION OF DR. J. LESLIE DAVIS, F. A. C. S.

MIDDLE NASAL TURBINAL ABNORMALITY, FUNDAMENTALLY RESPONSIBLE FOR MANY COMMON ILLS REGARDED USUALLY AS OF DOUBTFUL OR UNKNOWN ORIGIN

It is my purpose to undertake herein a further discussion of the responsibility of certain definite intranasal abnormalities as the prime cause of sundry diseases widely prevalent, difficult of treatment, and generally regarded as but rarely amenable to cure.

While these diseases have long been known to be associated with or complicated by more or less intranasal disturbance, yet so indefinite have been the observations as to any exact site or character of the nasal phase of the problem that but few have ventured to assign to them the importance of etiologically fundamental factors.

Two conditions to which, usually, the greater attention has been directed in attempts to evaluate the nasal factor are septal irregularities, deflections, spurs, ridges, etc., and active infections of the paranasal sinuses, acute and chronic.

Turbinal abnormalities seem usually to be appraised upon a basis of the degree to which respiration is impeded; and since the inferior turbinal occupies a position more directly within the normal respiratory channel, and also is the one most subject to turgescent variation, it naturally has attracted greatest attention. It likewise, for the same reason, has received undue consideration in the matter of treatment, topically and surgically.

Practically all inferior turbinal variance from the normal is passive and secondary to some regional primary lesion; therefore very few inferior turbinals require local treatment other than palliative, inasmuch as its obstructing interference will subside on the elimination of the contributing influence. During

twenty-seven years' practice I have not resected either the whole or part of an inferior turbinal in more than a half dozen instances.

Regarding the middle turbinal, however, conditions are entirely different, for I am fully convinced that it is the most common abnormality within the nasal channels, and at the same time the most potent causal factor in a wide range of disease processes. I am further convinced that these malformations are hereditary in origin, in numerous instances harmful to health through the mere abnormality, but much more so when altered by pathologic changes, both in their own and adjacent structures, and through which there is established an intricate and pernicious influence sufficient to produce an important group of common maladies, generally regarded as etiologically obscure. There, of course, may be, and usually are, other factors, local and constitutional, ofttimes many, that play important rôles. In fact, it is usually those associated and complicating factors which determine the character of the eventual disease entity, and of its symptomatology through the various stages of development and progress; nor is it out of place to add in this connection that those complicating factors constitute the chief difficulty in effecting a complete cure in some cases even though the original and fundamental cause be effectively eradicated.

The failure to obtain a cure in any given case by operation upon an intranasal abnormality or morbid condition does not necessarily disprove the etiologic theory, but may attest rather to the incompleteness of the operation in eradicating either the original lesion or the resulting pathologic changes. Neither does it follow that the more extensive the operation, the more perfect will be the result. Thoroughness in any surgical procedure, and especially within the nasal chambers, is a matter of precision rather than of scope. It is important that the original malformation be completely removed, but when the adjacent or neighboring tissues which have undergone pathologic change are dealt with, it becomes a matter for careful consideration as to the degree of eradication required. Each case in that respect becomes a law unto itself, though one general rule holds good at all times with reference to the handling of pathologic changes

surrounding the primary site; better to destroy too little than too much in a field of so intricate and highly sensitized structures, endeavoring to eradicate all new growth and all tissue which may have degenerated beyond hope of restoration, and to preserve not only all healthy membrane but likewise all partially affected tissues that through subsequent treatment might be reclaimed. Such a course of conservatism may occasionally necessitate a second or even third operation; but better so, with ultimate success, than to frustrate further hope by too radical procedure when in doubt.

In July, 1923 I read before the Colorado Congress of Ophthalmology and Otolaryngology an article entitled "Latent Evils in Congenitally Deformed Middle Turbinals, Later Manifested When Supplemented by a Focus of Chronic Infection," which was published in the Therapeutic Gazette (February 15, 1924). In that article I submitted the proposition that "in the existence of a certain type of abnormal middle turbinal rests a latent noxious influence which, when supplemented by the intermediate influence of a focus of chronic infection (most frequently located in the faucial tonsils), may become a potent etiological and perpetuating influence upon a group of common diseases."

I shall omit in this article any detailed discussion of the influence of chronic tonsillar disease toward creating and perpetuating a favorable field for infection and degenerative changes within the nasal chambers and paranasal cavities, in order that more space may be devoted to further discussion of the intranasal lesion and the maladies resulting therefrom. The existence of diseased tonsils, however, in any case must be dealt with promptly in order that the most favorable resistance, both local and general, may be enlisted in nature's struggle toward elimination and repair.

In my previous article it was stated "The grounds upon which my deductions are based are largely clinical; and while the evidence herein cited cannot be regarded as conclusive, yet when a certain pathology, not merely of function but also of definite anatomic lesion, is observed to coexist in a high degree of uniformity with certain related disorders, and that the mani-

festations of those disorders are favorably influenced in a fair measure by the removal of the specified lesion, the stated hypothesis seems not without a fair measure of justification."

It was pointed out that the middle turbinal malformation referred to was not accidental but congenital, representing a developmental deviation from the normal, consistent with recognized laws of heredity, and that the symptomatology of the resultant morbid processes depended largely upon the degree of abnormality, plus other associated influences, complications, and excitants. My belief in the soundness of the principle then advanced was based upon the high degree of consistency with which the specified anatomic abnormity was found associated with a group of diseases, manifesting a more or less analogous syndrome, and showing a tendency to appear in certain families from generation to generation, with added evidence of the marked uniformity with which the development, progress, or existence of the resulting symptomatology in any case, whether mild or distressing, was modified or completely relieved by the surgical elimination of the ascribed cause.

Type or Degree of Middle Turbinal Aberration That May Be Regarded Noxious.—To appreciate any variation one naturally must have an intelligent conception of what may be regarded as normal. Since no one has yet so clearly described the anatomy and relations of intranasal and paranasal structures as J. Parsons Schaeffer, I am glad to have the privilege of making several quotations from his most admirable treatise, "The Nose and Olfactory Organ."[1] "The middle nasal meatus is the most important and complex of the nasal meatuses, and is developmental and topographically divided into ascending and descending rami, . . ."

"Moreover, the middle meatus is largely overhung, and its contained structures—the minor or accessory nasal conchæ and meatuses and portions of the ethmoid cells, together with the ostia of the latter and those of the frontal and maxillary sinuses—are hidden from view by the valve-like operculating character of the middle nasal concha. Indeed it is necessary to entirely

[1] P. Blackiston's Son and Co., Philadelphia.

ablate the middle concha in order to expose the middle nasal meatus for a detailed study." It is important to remember that "The skeleton of the middle concha is not an independent osseous element, but an appendage of the lateral ethmoidal mass. Over it is stretched a thick mucous membrane rich in venous networks, that assume the character of an erectile tissue. . . ."

"Occasionally the lobule of the middle concha assumes large dimensions and mechanically obstructs the middle meatus at this point. Indeed the mass may crowd the nasal septum toward the opposite side." The latter statement, I believe, is erroneous, that the large size of the middle concha *does not cause* the deflection of the septum toward the opposite side any more than the deflected septum causes the enlargement of the concha. It is my opinion that the dual abnormality is a synchronal development resulting from the same genetic influence. From my article upon this subject, previously referred to, the following paragraph upon this point is more elucidative: "The phase of hereditary influence will be elaborated in a later subdivision of the subject, but at this stage of the discussion it is deemed more important, first, to make clear the identity of the particular type of turbinal malformations with which my hypothesis is concerned. In the majority of cases it will be found to be a unilateral hyperplasia of the body of the turbinal structure, with a corresponding deflection of that portion of the nasal septum directly opposite, and a correlative underdevelopment of the opposite middle turbinal. The typical septal deflection concerned in this process involves essentially the perpendicular plate of the ethmoid, and when it is taken into account that all of these structures, the perpendicular plate and the two turbinals, are continuous parts or divisions of a definite unit, the ethmoid structure, and not separate and distinct units in themselves, the whole abnormality can be conceived as an embryologic deviation from the normal. That is, the relative sizes of the turbinals and the position of the septum, being purely an adaptive conformation, are fixed wholly by heredity. I, therefore, do not concur in the opinion sometimes advanced in explanation

of these abnormalities to the effect that the deflection of the septum is the result of pressure exerted by an overdeveloped turbinal; nor, conversely, that the deflected septum by pressure against the turbinal on the side of its convexity produces an atrophy or underdevelopment of that structure, while the enlarged turbinal that fills the space in the concave side of the deflection represents a compensatory hypertrophy. I am fully convinced that the enlarged and malformed turbinal, as herein described, instead of possessing any increased function is, in reality, deficient in every phase of function with which the normal structure is endowed."

The normal middle turbinal, then, being an appendage springing from the superior border of the medial ethmoidal mass, should occupy a dependent position, hanging freely between the nasal septum medially and the ethmoidal wall laterally, but not in contact with either wall except, perhaps, when in a more or less markedly turgescent or inflamed state. Furthermore, the body of the normal turbinal, thus suspended, is not fixed in a rigid position, but may be moved somewhat to either side with but slight pressure exerted with a probe or other examining instrument.

Arbitrary Division of Aberrations Found.—*Type 1.*—Those that show variations from the normal in conformation, size (always increased in skeletal structure, with more or less hypertrophy of enveloping membrane) and position, the latter being of greatest importance. They may or may not contain aberrant ethmoid cells. This class, usually, is not complicated by extensive pathologic changes, particularly degeneration with polyp formation, in the turbinal body itself or in the adjoining ethmoid structure. *Its position is fixed, being rigidly impinged against the lateral nasal wall. It is from pressure against the highly sensitized ethmoidal structure in the middle fossa which sets up the reflexes necessary to produce the resulting maladies.* The scope of this article will not permit of a discussion of the physiological processes involved, when certain sensory and sympathetic nerve fibers, through pressure, irritation, or obstruction within the middle fossa, are incited to varying degrees of perturbation.

Though complex, it seemingly has been very rationally explained by various authors.

Type 2.—This type has all of the usual physical characteristics of the first, and in addition, either through more or less chronic low-grade inflammation, or merely from pressure, has undergone extensive pathologic change both in the turbinal body itself and in the adjacent ethmoid structure. Polypoid tissue is always found in the middle fossa (of this class) and probably also in some of the ethmoid cells, principally anterior, though they may not have been visible on examination prior to ablation of the turbinal. It is more frequently unilateral but may be bilateral, and there usually exists considerable increase in size. When the degenerative changes are bilateral, that of the larger turbinal (on the concave side of the deflected septum) is apt to be the source of greatest trouble.

Ewing, in his text-book on Neoplastic Diseases states: ". . . Nevertheless, it is quite clear that in the nares more than in any other mucous membrane the polypoid outgrowths of chronic inflammation lack the histological features of an autonomous new growth. In fact, as Chiari claimed in 1887, many of them consist of nothing more than localized edematous areas of mucous membrane rendered protuberant by mechanical means, but without other changes. Once established, however, these masses are subject to various grades of hyperplasia of their elements which render them not only persistent, but often progressive, and in such cases there may be considerable change in the appearance and proportion of various cells. Since this change is seldom pronounced, the groups of nasal polyps must stand among the purest examples of pseudoneoplasm of inflammatory origin.

"Nasal polyps are probably always preceded by chronic rhinitis and Tissier traces an unbroken series of cases from simple chronic rhinitis through hyperplastic rhinitis to polypoid inflammatory outgrowths. The tumors appear chiefly in young subjects and infants, rarely after thirty years, generally at the ostia of the mucous sinuses opening into the nares. Empyema of these sinuses is a common antecedent."

Type 3.—This class of middle turbinal is radically different from 1 and 2 in that while there is abnormality in conformation and size and also in subsequent pathologic change, its relation to the middle fossa is not the essential factor. The turbinal body seems to have developed posterior to the usual location, or rather as though about as much as the anterior third were very much underdeveloped; the remaining portion is overdeveloped, but manifests distinct degenerative change and is rigidly impinged against the posterior portion of the *septal wall*, instead of the lateral wall. In some cases the central and posterior part of the middle fossa seems also occluded, but the septal pressure is constant. This condition may be unilateral or bilateral, and in some cases the hypertrophy seems sufficient to cause pressure also against the sphenoidal wall.

SOME COMMON MALADIES OCCURRING IN CLASS 1 MALFORMATIONS

Headache, Neuralgia, Neuritis, Neurasthenia, Amnesia, Hysteria, Ocular Affections, Dysmenorrhea, Tinnitus Aurium, Varying Degrees of Dizziness and Vertigo and Chronic Digestive Disturbances.

Explanation for the variableness of effect produced from a common cause in different individuals, just why this or that symptom should predominate in any given case, or why, as I have observed in a few instances, the supposed essential etiologic intranasal pathology may be present, yet without any manifestations of disease either subjective or objective, must be based upon the fact that the local lesions are never in all respects the same in any two cases. Furthermore, not only the diversity of local factors, but also variations in the individual element and external influence play a complicated rôle.

Headache, being by far the most common, and also the most important of the group enumerated in this class, I shall discuss this malady first and more or less in detail.

The term "headache" without some qualifying limitation is bewildering. Even when all manifestations of intracranial lesions, acute infections of the paranasal sinuses, syphilis, arterio-

sclerosis, pituitary disease, etc., are excluded, the remaining varieties of discomfort so designated are wide in range, variable in degree, and altogether complex in a diversity of associated phases.

Migraine, being unquestionably the one most definite type of headache, with its characteristic syndrome, and also because of its importance with respect to both its common occurrence and the intensity of distress induced, is chosen for more or less detailed consideration.

I wish to state at the outset that of the several hundred patients that I have operated upon for headache a large number of them have presented a symptom complex conforming to that of typical migraine, and that the results have been uniformly satisfactory in nearly all. It was this type of malady that first attracted my attention to the constancy with which I could demonstrate in every case, without exception, the abnormality of middle turbinal which I eventually designated as etiologically essential.

From this I became further interested in the hereditary phase of a group of diseases that presented in their syndrome certain common characteristics, and the fact that in all of that group the same distinguishing features attended the intranasal lesions. I began then to make examinations of all members of any family in which one or more suffered more or less similar complaints, and wherever opportunity was presented, it was found that turbinal abnormalities were repeated from generation to generation seemingly in about the same degree of regularity as would conform to the recognized laws of heredity.

Church and Peterson, in their text-book, "Nervous and Mental Diseases," define migraine as follows:

"Migraine is an explosive, paroxysmal psychoneurosis. The attack, usually commencing with sensory and mental symptoms, is almost always attended by headache, which is frequently one sided, and there is generally nausea and vomiting. It is sometimes called hemicrania, sick headache, or megrim. Owing to the vomiting, it is often erroneously attributed to 'biliousness.'"

Under *etiology* they state: "Heredity is strongly marked.

It is more commonly direct than in almost any other neurosis. Migraine may sometimes be traced through several generations, numbering dozens of cases in a single family tree. Any neuropathic family is almost sure to present cases of migraine. It seems capable of transmission by transformation, alternating with hysteria, epilepsy, and insanity. It may be associated with the graver neuroses, or with psychoses in a given patient. Gout and arthritism have similar close relations with it. Thirty per cent. of cases begin between five and ten years of age, and the balance appear mainly at puberty, adolescence, and during early adult years. In rare instances it may begin after thirty. The female sex is somewhat more commonly affected than the male.

"The inciting cause is often obscure. Some cases date from periods of lowered physical health arising from any cause. The cases beginning in early childhood very frequently follow the first systematic use of the eyes for near vision, as in schoolwork. Eye-strain, arising from accommodative or muscular asthenopia, is certainly competent to incite migrainous attacks in those predisposed. Gouty or lithemic conditions, constipation, indigestion, fatigue, lactation, emotional disturbance, or any febrile movement may set up the attack."

Partly because of the vividness of their description, and because certain features brought out that are of interest in relation to my own theory pertaining to essential cause, I wish to quote at further length from the same authors:

Symptoms.—"The headache is the most uniform, dominant and distressing symptom. It varies in different cases in degree, duration and location, but is commonly intense and ordinarily circumscribed, at least at first. Often commencing as a localized, intense pain in a small spot in the temporal, frontal, ocular, or occipital region, it gradually spreads to the head. Less commonly it commences on both sides as a frontal or occipital pain. Rarely, it passes down the back of the neck and into the arm. The character of the headache is tolerably uniform in the same case, but some patients have several varieties, which reappear from time to time, and are recognized as old acquaintances. The

character of the attack may also undergo great modifications during the patient's lifetime. The headache lasts from one or two hours to ten, twenty or forty, and may subside abruptly after nausea and vomiting, or gradually grow less and disappear. During the height of the headache the patients usually shun light and noise, and remain as quietly recumbent as possible. Movement such as rising or stooping intensifies the pain. Tenderness of the scalp or nerve trunks is unusual.

"In most cases nausea appears after the headache develops or has reached its height, and there is complete anorexia. Digestion appears to be stopped, as unchanged food is sometimes vomited many hours after its ingestion."

Pathology.—"In the absence of knowledge regarding the morbid anatomy of migraine, we are thrown back upon theories and analogies. Attracted by the vasomotor symptoms many attributed the migrainous attacks to disturbance of the sympathetic. This is a clear confusion of effect and cause, of symptom and disease. Taking into consideration the cortical features manifest in sensory disturbance, hemiopia, tingling, aphasia, motor loss, crossed hemicrania, mental features, cardiac and digestive inhibition, and the vasomotor disturbance itself, there can be little doubt that migraine is a cerebral disorder. Its resemblance to epilepsy, if not its actual relationship, points to the same conclusion. The exact nature of the cortical instability is for the future to reveal."

Regarding epilepsy I wish to say that I have had unusual opportunity for special study of this disease over a period of three years, during which time I have operated upon 210 cases. A detailed report of that study will be made at another time in a separate article. Suffice to say at the present time, however, that the turbinal pathology in that malady conforms to the abnormalities herein described in a more marked degree than in any class of cases I have yet studied.

The most frequent unilateral type of headache, variable in intensity, that I have encountered is first felt about the eyes and over the forehead, frequently accentuated at the supra-orbital notch and along the distribution of the supra-orbital

nerve. It may remain confined to that region for a short time in mild cases and disappear. Where it persists, which it more frequently does, for a few hours or even the whole day, rarely longer, it becomes more and more severe, radiating over the temple to the parietal or postauricular region, eventually to "settle" and become most intense in the occiput and back of the neck. The pain is very similar to that of a real migraine attack, but without the complete migraine syndrome. Neither sex seems to predominate, and it makes its first appearance around puberty, though I have seen cases at a much earlier age. It may then occur at irregular intervals, most frequently and with greatest intensity through the third and fourth decades. The turbinal pathology in these cases is typical, and complete relief is obtained by operation in nearly 100 per cent. of cases.

There is a common type of bilateral headache, described by B. Landis Elliott of Kansas City, in a symposium article on "Headache from the Neurological Aspect."[1] He says: "We find sometimes that the patient suffers not so much from actual headache or pain as from a sensation of discomfort or distress. This may be described as a feeling of pressure, a feeling of emptiness or fulness, or sometimes a band about the head. When a patient tells us that he has suffered constantly with headache for years and we find upon close inquiry that the headache has some of the features just described, we must at once think of neurasthenia, especially if he has been able to sleep in spite of his discomfort. This is probably the most frequent form of headache, with the exception of migraine, and is closely related to the fatigue or exhaustion headaches occurring in individuals who otherwise enjoy good health." That is the type of headache in which I have most frequently found bilateral enlargement of the middle turbinals and rigidly impinged against the lateral walls. Complete relief in a high percentage of cases is obtained by resection of the middle turbinals.

Elliott also describes "the typical hysterical headache, the so-called clavus hystericus or hysterical nail. The patient often describes it as the sensation of a nail being driven into the

[1] Jour. Mo. Med. Assoc., Nov., 1928.

skull at the vertex. The pain is usually localized to an area not larger than a half dollar. It may last for hours, days, or weeks. Sometimes an obstinate posterior headache which may radiate to the temples and forehead is noted in hysterical patients. Hysterical headache may occur in combination with headache from other causes in the same patient. In all these cases one must search carefully for hysterical stigmata, absence of the corneal reflex, pharyngeal anesthesia, hemianesthesia, etc. The fantastic character of the complaints and the character anomalies of hysteria which are sometimes present may aid in establishing the diagnosis in a doubtful case."

Bowers[1] defines hysteria as follows: "A psychoneurosis which occurs usually in individuals who possess highly neurotic and unstable constitutions. The disease is manifested by emotional episodes, increased susceptibility to external impressions, periods of depression, and marked sensory, psychic, and motor disturbances." Regarding etiology he considers heredity the most important factor, a family history of insanity, epilepsy, chorea, or alcoholism being found in about 80 per cent. of cases. Males suffer to same degree as females, its first appearance is usually in early adolescence though it may occur earlier and later, and is often associated with organic psychoses.

Typical hysteria, as well as less pronounced neurotic manifestations, I have no doubt are another phase of disease resulting from the same hereditary pernicious nasal lesion, inasmuch as hysterical traits are so commonly observed cropping up in the symptom complex of practically the whole group of diseases associated more or less with hereditary influence. Neurotic tendencies have been common in many of my own cases, and regarded as a part of the disease, though I have never had a case of typical "clavus hystericus."

In the same symposium on "Headaches" in which Dr. Elliott's paper was presented was another of interest by Dr. Lawrence Post, of St. Louis, on "Headaches of Ocular Origin." He analyzes 610 cases from his own practice, from which I shall quote

[1] Manual of Psychiatry, published by W. B. Saunders Company, Philadelphia.

several points applicable to the study of intranasal lesions as affecting eye disorders. He states: "I expected to find that most of these headaches would prove to be of ocular origin, but only about 65 per cent. impressed me, after careful study, as being due to refraction or muscular troubles. An analysis of the other 35 per cent. indicated that the largest number of cases was undoubtedly due to nasal disease; some were apparently digestive, some from high blood-pressure, an occasional one from low, some were typical migraine and, parenthetically, I might remark that I excluded migraine from the group due to ocular trouble as I believe this disease to have other basis, and then of course, without enumerating others, there was the group of those for which no etiology was ever determined. . . . An analysis of the nature and location of the headaches revealed that of those who mentioned specific location, and it is important to note that the majority did not complain of any particular region, by far the most frequent was frontal, being two-thirds of the total, and of these about one-half were unilateral. Next in frequency were the occipital and next those at the top of the head.

"The types of errors of refraction chiefly associated with headache were, as expected, hypermetropia and hypermetropic astigmia. The next most frequent cause was imbalance of the extra-ocular muscles, but this occurred scarcely one-fifth as often." Regarding relief obtained by refraction he states: "The best results were obtained in the group of those who complained of general headache without any particular location having been recorded in the history. Sixty-four per cent. of these were rendered comfortable. The bilateral frontal group was next with 60 per cent. relieved. Pain in the vertex was seldom helped and occipital pain in only 22 per cent., while no case of unilateral headache was entirely alleviated by the ocular treatment. These unilateral cases I believe were almost all due to sinus infection and many of them were helped by nasal treatment."

It is interesting to note that the unilateral cases, and those with occipital headaches, with which Post had least success, are

the ones which I have found most frequently associated with turbinal abnormality, and which usually give the most satisfactory response to operation. Regarding vertex headaches, however, I have never found any evidence that would associate them etiologically with any intranasal pathology. That various types of refraction errors, as well as the associated headaches, may be brought about by middle turbinal pressure lesions is very probable. My attention was first attracted to this class of conditions by inquiries of an occasional patient (who used eye glasses) some weeks or months after turbinectomy for headaches as to whether the operation could have injured his eyes, stating that since the operation his glasses did not seem to be right. On having him consult his oculist it would be found that the previously recorded errors were greater than that found in the recent test, whereupon, to use the common lay expression, "weaker glasses" corrected the trouble.

That the middle turbinal lesion often is the essential cause of chronic or recurring ulceration of the cornea, I am quite positive. I have had several cases that had persisted in spite of treatment by skilled oculists over periods varying from a few months to two years that cleared up promptly following middle turbinectomy. These cases were all unilateral, and all adult males.

There is a bilateral type of abnormal middle turbinal, markedly enlarged in skeletal structure and enveloped with excessively hypertrophied mucosa, I have found not uncommon in association with periodic attacks of urticaria, distressing in character. In two of these cases the excessive swelling and irritation invaded the mucous membranes as well as the face and body, and both were cured by complete double turbinectomy.

Under *etiology*, Stelwagon and Gaskill[1] state: "Urticaria may occur at all ages and in both sexes, and in all countries. It is much more frequent, however, between the ages of early childhood and middle adult age, and is possibly somewhat more common in the female sex. There are many causes, but there is

[1] Diseases of the Skin, 9th Ed., published by W. B. Saunders Company, Philadelphia.

some peculiar individual predisposition necessary, inasmuch as the same cause may not produce the eruption in different subjects. In some instances a hereditary influence or predisposition is observed, especially in the cases associated with giant lesions and edematous swellings."

Many cases of facial neuralgia (including two of obstinate tic douloureux), dizziness, vertigo, and tinnitus have also yielded to the same treatment.

I not infrequently have seen patients who had been living in a state of more or less constant fear and apprehension of impending death because of an existing or periodically recurring attack of vertigo, which they had imagined, or their physician had misinterpreted as some serious form of heart affection. The complete relief commonly resulting from correction of the turbinal lesion, therefore, has led me to believe that far more cases of vertigo originate within the nasal fossæ than from all other causes combined. I have seen complete and lasting cessation of obstinate tinnitus aureum to ensue as a result of middle turbinectomy far oftener than I have ever been able to obtain from any form of treatment directed toward the aural mechanism itself.

Type 2.—Maladies commonly resulting from this class of complicated turbinal lesion include those usually spoken of as nasal neuroses, and not only those of mild degree, such as paroxysmal sneezing, disturbed olfaction, anesthesia, hyperesthesia, etc., but also the two major maladies, asthma and hay-fever. It is these latter two that I shall consider at greater length in this discussion.

The terms "bronchial asthma," "true bronchial asthma," "cardiac asthma," "renal asthma," "asthma of possible nasal origin," etc., suggest the diversity of opinion upon the etiology of a malady which, regardless of its variation in underlying factors, of its wide diversity in complicating influences, and of its innumerable external excitants, still presents the same symptom complex differing only in point of intensity.

While practically all writers give prominent consideration to the nasal aspect of asthma, and many admit a nasal causal

factor in some cases, I know of none who has called attention to a definite anatomic lesion, whether altered by malformation, malposition, or chronic pathologic change, commonly found in any class of cases, even those designated as nasal asthma, and to which was assigned the rôle of essential cause.

Most authors who admit a nasal causal factor in some cases of asthma, usually attribute the reflexes produced to more or less indefinite abnormalities affecting the septum, or to any existing sinus infection with the associated engorgement of the nasal membrane, or else a mucous polyp. All such sources of irritation are important as complicating factors and must not be ignored. On examination they are more obvious than the majority of diseased middle turbinals which usually are so closely impinged against the lateral wall as to disguise their own noxious condition and relation to the neurosis in question. The altered tissue of the diseased middle turbinal itself is rarely visible from either anterior or posterior inspection, and especially is the complicated condition in the middle fossa and ethmoid cells completely hidden by the enlarged overhanging turbinal. *That the degeneration process with more or less polypoid formation is always present in some measure in every case of asthma or hay-fever, I have been able to verify in all cases operated upon, most of which were not demonstrable before operation.* The polyps are more frequently small and multiple, though occasionally there may protrude one or more large ones.

P. Watson Williams,[1] Bristol, England, in 1910, treated the subject of nasal neuroses in a most interesting and thorough manner, but stopped just short of recognizing what I believe to be the primary and essential lesion in asthma and hay-fever. I wish to make several quotations from his observations, though not from consecutive paragraphs: "Paroxysmal sneezing may be due (*a*) to reflex peripheral irritation, as in the earlier and milder forms of true hay-fever, in which the symptoms appear only when the patient is exposed to pollen, etc., and in cases due to some local abnormality in the nose; or (*b*) to a central neurosis, *e. g.*, tabes." Under predisposing causes: "The exciting causes

[1] Text-book, Rhinology.

are universal, the predisposing are very common, while the affection itself is relatively rare. Thus a third factor is generally necessary, and this is found in the abnormalities and morbid conditions of the nasal passages."

Under sensory neuroses he observes: ". . . On the other hand, in many cases which at first sight appear to be pure neuroses, further careful search will reveal an adequate local cause for the condition of the patient, the removal of which will alone effect relief. Indeed, inasmuch as the nasal mucosa is a highly sensitive area which is in health the region for excitation of numerous physiological reflexes, it is inevitable that correlated reflex areas should sometimes be pathologically excited through the nose, in accordance with the law of irradiation of reflex action, viz., that reflex action extends from nervous areas in which it first operated to neighboring afferent nerve areas by means of the communication between the different groups of ganglionic nerve cells. Thus reflex nasal neuroses most frequently excite physiological reflexes and other symptoms in the upper respiratory tract, *e. g.*, sneezing, coryza, and vascular turgescence; next in frequency, morbid reflex phenomena in the lower tract, *e. g.*, asthma, vasomotor bronchitis, while only very rarely are epilepsy, melancholia, cardiac symptoms, etc., dependent on nasal sources."

He observed, as others have, that small polypi were more frequently found associated with asthma than were large ones, stating: "The usual explanation is that large polypi, though causing more complete stenosis, are less mobile, and therefore probably less likely to irritate the neighboring mucosa." He then adds, "The real explanation probably is that the small polypi are the result of ethmoidal cell suppuration, and that the latter condition is the cause of local irritations and asthma, the polypi in themselves having little to do with the matter." I am entirely in accord with that statement as far as it goes, but what he omits is, in my opinion, the important feature of exact location,—that of the middle fossa, and that polyp formation, in some measure, is a part of the altered structure process found in every case of asthma, though in most cases concealed by the

overhanging turbinal body. The fact that the existence of polypi is often unobserved prior to operation explains his remark: "Often we shall discover nothing beyond hypertrophic rhinitis, edematous mucous membrane, or vascular engorgement of the turbinal bodies." Also another statement, in the nature of a conclusion: "The very large percentage of patients with large nasal polypi who do not suffer from asthma, and the very large percentage of true asthmatics in whom no polypi can be found, tend to prove fairly conclusively that there is no direct connection between nasal polypus and asthma as cause and effect."

Practically all that has been said regarding asthma may be applied also to hay-fever. I believe that in these maladies there exist the same fundamental etiologic factors, differing, it may be, in degree of turbinal abnormality, intensity of pressure against the lateral wall, expanse of nasal area, extent of invasion of tissue change in the ethmoidal mass, etc. I know that from the same surgical procedure and similar subsequent care the results have been uniformly satisfactory in a high percentage of cases.

Type 3.—Under this type of turbinal abnormality there is but one disease which I wish to report as commonly occurring therewith, and that is the distressing form of atrophic rhinitis, commonly called by the name of its prominent clinical symptom, ozena. Since my attention was first attracted by this relation, about fifteen years ago, I have not seen a single case of "ozena" that did not manifest the peculiar turbinal lesion, nor has the complete resection of the lesion failed to cure the malady. I had never found this peculiar association between the malady and this definite type of turbinal mentioned by any writer till recently while reviewing the subject (having consulted over sixty text-books on rhinology), I found this paragraph in Watson Williams' Rhinology: "There is considerable diversity of opinion as to the pathology of atrophic rhinitis, and it must be confessed that the actual pathology of this common affection is at present an open question." Then follow several different views advanced, among them being: "The view is held by Berliner that it is associated with nasal obstruction and due to

pressure of the middle turbinal against the *septum*, with consequent defective secretion." Watson Williams says further, "The disease may be unilateral and is often more pronounced on one side than the other. Though heredity appears to have some influence—ozena is essentially a disease of puberty and young adult life, and the majority of cases are found in females. . . . Possibly the disease is a clinical rather than a pathologic entity, and the symptoms may occasionally be due to a communicable infection, thus differing from the great majority of cases. . . . The disease has been attributed to the action of many different micro-organisms."

Space will not permit of any further discussion of individual diseases, so I shall confine myself in the remaining time to remarks applicable to the entire group.

GENERAL REMARKS

It is worthy of note that all of the affections herein attributed to the influence of middle turbinal variations from the normal, plus certain subsequent pathologic alterations, have long been observed to manifest a more or less characteristic hereditary phase. From my investigations upon the subject over a period of twenty years I am convinced that the ethmoid bone in its genetic development is prone to irregular deviations from the normal in a considerable proportion of the human race. These aberrations may be observed from early childhood to maturity in the form of distortions of the nasal septum and middle turbinal structure, the latter being the more important from the standpoint of pathologic lesions. They are rarely the result of accident, but originate in conformity to recognized laws of heredity, eventually to become the primary and essential factor in the genesis of many morbid processes. These morbid processes, though varying widely, perhaps, in the characteristic feature of their manifestation, nevertheless present in their general symptom complex certain more or less analogous phases.

Conditions contributing to the pathologic alteration of tissue in the middle turbinal and adjacent ethmoidal structures seem to be a continuous low grade or "silent" infection, with or with-

out visible purulent suppuration. In some cases it may be merely pressure hypertrophy. Other intranasal abnormalities, such as septal deflections, ridges, spurs, or synechiæ, and even active purulent sinusitis, unless it involve the anterior ethmoid cells in association with abnormal middle turbinals, with or without prominent polypus production, I believe to be complicating factors but never of fundamental importance. Any such associated irritants, however, in the course of treatment must be eradicated in order that the nose and sinuses may be restored to as nearly the normal state as possible. A predisposing constitutional condition upon which many have laid stress is a necessary factor, to be sure, but the predisposition is probably a matter of several combined factors, just as the local cause is a complex process depending upon certain pathologic changes added to an existing potential primary lesion. The incidence of heredity applies to a constitutional predisposition, the same as to turbinal abnormality, to be increased or diminished later by various and sundry influences. Even the predisposition itself may be a result of the abnormality instead of an independently contributing influence. An external irritant or exciting factor is likewise necessary to the attack, but upon that phase there are few, if any, discordant views. Anaphylaxis, protein sensitization, hypersusceptibility or by whatever name it may be designated, is nothing more than a state arrived at through the ultimate pathologic complex which began with the turbinal abnormality, and without which primary lesions could not have developed.

It must be remembered that the anterior portion of the middle turbinal may appear practically normal in some of those most affected throughout the remaining part of the structure, and that the active complex lesion is obscured by the dependent portion impinged against the lateral wall. The middle third or the anterior part of the posterior third of every abnormal and diseased middle turbinal is always the most offending portion of the structure. Hence it always has been my intention, *without exception*, where any part of the middle turbinal was deemed in need of removal, to perform a complete and clean extirpation.

Anticipating the criticism that the complete removal of the middle turbinal may be productive of atrophy, or that it exposes the ethmoid sinuses to increased susceptibility to infection, I wish to say that there could be no greater error in judgment. In the first place the incidence of infection even in the normal sinuses depends not so much upon the exclusion of supposed foreign bacteria as upon the integrity of inherent agencies of resistance. One might as well argue that the occlusion of a nasal passage would protect its lining mucosa from infection, for the *normal middle turbinal*, by its conformation and position, favors rather than obstructs sinus ventilation. The abnormal turbinal then influences sinus infection in proportion to the degree to which its hyperplasia and malformation restrict normal sinus ventilation and its removal restores in some measure at least that factor of function.

If, then, it can be demonstrated that the primary factor is a definite anatomic malformation, to which must be added other definite pathologic changes before an individual, definitely predisposed constitutionally, can be affected by any particular external irritant, then the matter of relief or cure is established upon a rational basis. I believe that it can be done.

In closing I wish to say that it is not without a full realization of the distinguished opposition that my position upon this whole subject will invite. Nevertheless, I am willing at this time definitely to affirm that the primary and essential cause of the maladies herein discussed is contained in the specified lesion of the middle turbinal and ethmoid structure. In other words, whatever predisposing constitutional state, whatever pathologic process within the nasal chambers or elsewhere, and whatever external irritant may be necessary for the occurrence of such paroxysmal "explosions," the mechanical stimulant or impulse must emanate primarily from lesions within the middle nasal fossa and its adnexa, else the complex reflex neurosis, or whatever it may be, necessary to incite the syndrome which characterizes each particular malady could not otherwise occur.

ADDENDA

To illustrate the progress of development of intranasal and paranasal structures at various stages, from four and a half months fetal life to early adult maturity, I have selected and appended herewith illustrations of eight specimens of the Warren B. Davis collection at the Daniel Baugh Institute of Anatomy, Philadelphia, which have been already published by the W. B. Saunders Company.

I have added under each original legend a word regarding the point of interest in relation to my own article.

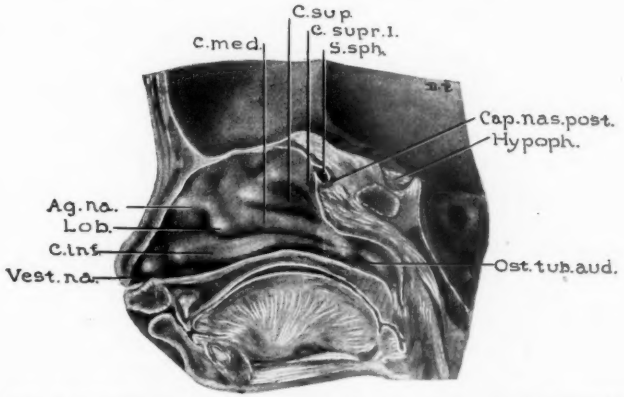


Fig. 472.—Sagittal section ¾ mm. to the right of median line anteriorly and 1¼ mm. to right of median line posteriorly through the body of the sphenoid. (Fetus one hundred and thirty-five days old. Series B, No. 1. × 1½.) Shows the lateral nasal wall and the developing sinus sphenoidalis which extends into the remnant of the posterior portion of the cartilaginous nasal capsule. The concha sphenoidalis (ossiculum Bertini) develops in that portion of the cartilage which forms the antero-inferior boundary of the primitive sinus sphenoidalis. *Cap.nas.post.*, Capsula nasalis posterior; *Hypoph.*, hypophysis; *Ost.tub.aud.*, ostium tubæ auditivæ; *Vest.na.*, vestibulum nasi; *C.inf.*, concha inferior; *Lob.*, lobulus; *Ag.na.*, agger nasi; *C.med.*, concha media; *C.sup.*, concha superior; *C.supr.I.*, concha suprema I; *S.sph.*, sinus sphenoidalis.

All structures and relations in this specimen appear to be normal.

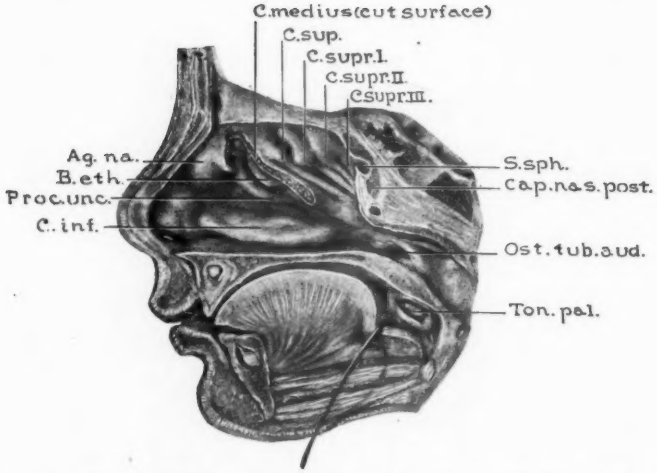


Fig. 473.—Sagittal section, median anteriorly, posteriorly 1¼ mm. to the right of median line. (Fetus one hundred and eighty-eight days old. Series B, No. 4.) The greater portion of the concha media has been removed in order to show the relations of the recessus conchalis, processus uncinatus, hiatus semilunaris, and bulla ethmoidalis. This specimen shows the presence of five conchæ ethmoidales, the only specimen in the entire series having so great a number. Note the extent of development of the sinus sphenoidalis. *C.med.*, Concha media (cut surface); *C.sup.*, concha superior; *C.supr.I*, concha suprema I; *C.supr.II*, concha suprema II; *C.supr.III*, concha suprema III; *S.sph.*, sinus sphenoidalis; *Cap.nas.post.*, capsula nasalis posterior; *Ost.tub.aud.*, ostium tubæ auditivæ; *Ton.pal.*, tonsilla palatina; *C.inf.*, concha inferior; *Proc.unc.*, processus uncinatus; *B.eth.*, bulla ethmoidalis; *Ag.na.*, agger nasi.

Chosen to illustrate the relation of structures in the middle fossa.

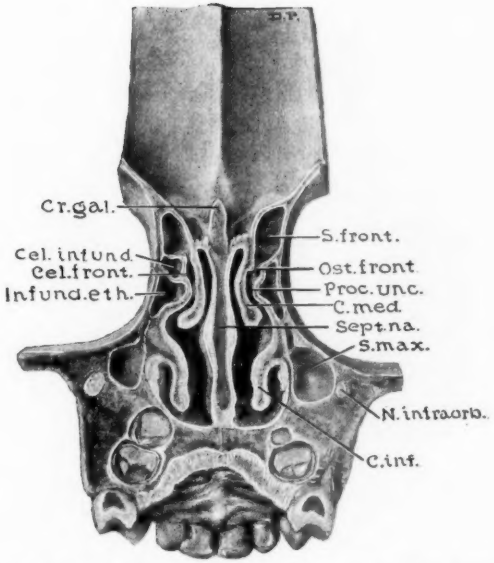


Fig. 474.—Specimen from a child two years, six months, and seven days old. (Series D, No. 24.) Posterior view of a coronal section 11 mm. posterior to nasion. Note that the ostia of the frontal sinuses are medial to the uncinate processes, thus do not communicate with the infundibulum ethmoidale. *S.front.*, Sinus frontalis; *Ost.front.*, ostium frontale; *Proc.unc.*, processus uncinatus; *C.med.*, concha media; *Sept.na.*, septum nasi; *S.max.*, sinus maxillaris; *N.infraorb.*, nervus infraorbitalis; *C.inf.*, concha inferior; *Infund.eth.*, infundibulum ethmoidale; *Cel.front.*, cellula frontalis; *Cr.gal.*, crista galli.

Structures and relations normal.

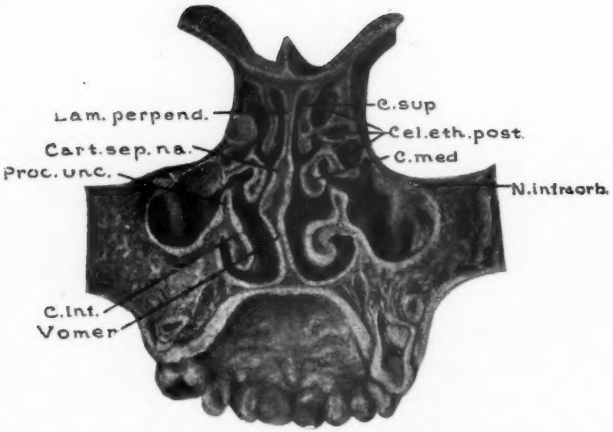


Fig. 475.—Specimen from a child, three years, five months, and eight days old. (Series D, No. 32.) Posterior view of coronal section cut 28.5 mm. posterior to nasion, showing the extent of lateral and supero-inferior development of sinus maxillaris, the osseous ridge beneath nervus infraorbitalis, cellulæ ethmoidales posterior, and small conchal cells developing in each concha nasalis superior. The ostia maxillaria are larger than usual in the anteroposterior diameter. Note deflection of septum nasi and its influence on each concha media. *C.sup.*, Concha superior; *Cel.eth.post.*, cellulæ ethmoidales posterior; *C.med.*, concha media; *N.infraorb.*, nervus infraorbitalis; *C.inf.*, concha inferior; *Proc.unc.*, processus uncinatus; *Cart.sep.na.*, cartilago septi nasi; *Lam.perpend.*, lamina perpendicularis.

Interesting depiction of general aberration of septum and lateral walls.

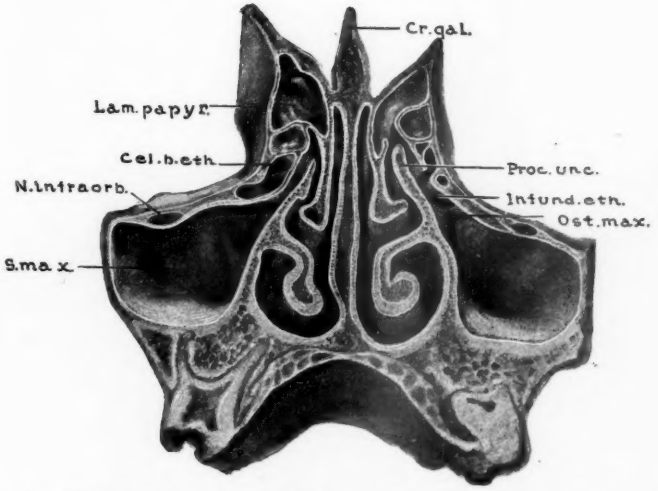


Fig. 476.—Specimen from a child nine years, ten months, and nineteen days old. (Series D, No. 65.) Anterior view of coronal section, cut 20 mm. posterior to the nasion, showing the size and relations of the sinus maxillaris, the ostium maxillare, and its manner of communication with the infundibulum ethmoidale, the bulla ethmoidalis, processus uncinatus, and cellulæ ethmoidales anterior. *Cr.gal.*, Crista galli; *Proc.unc.*, processus uncinatus; *Infund.eth.*, infundibulum ethmoidale; *Ost.max.*, ostium maxillare; *S.max.*, sinus maxillaris; *N.infraorb.*, nervus infraorbitalis; *Cel.b.eth.*, cellula bulla ethmoidalis; *Lam.papyr.*, lamina papyracea.

Structures fairly normal, with the exception of the right concha media, which illustrates a point mentioned by Schaeffer (The Nose and Olfactory Organ, page 90): "Not infrequently the middle concha undergoes enlargement at the genu in the formation of a distinct lobule. . . . Occasionally the lobule of the middle concha assumes large dimensions and mechanically obstructs the middle meatus at this point." This appears to be a type which may, later, without any other tissue alteration, give rise to headache from pressure.

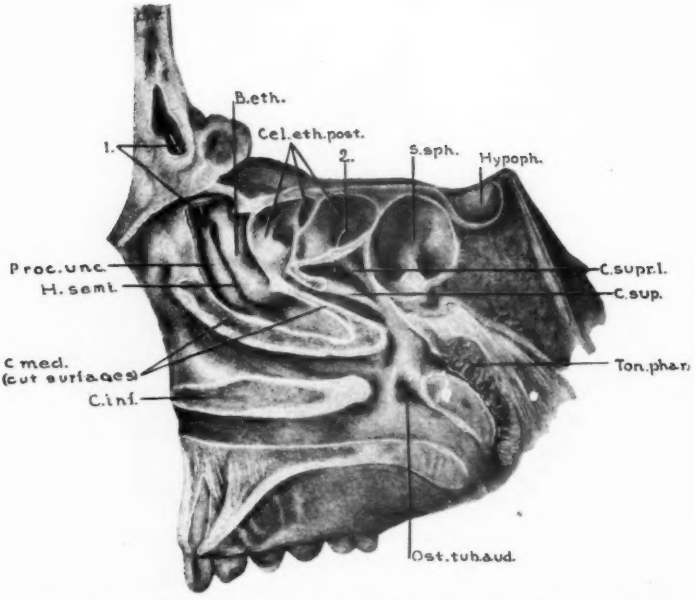


Fig. 477.—Specimen fourteen years and seven months old. (Series D, No. 73.) Sagittal section, cut 4 mm. to the right of the median line, thus removing the medial portions of the concha inferior and concha media, and the medial anterosuperior portions of the concha superior and concha suprema I. The relations of the structures forming the lateral nasal wall and the positions of the ostia of the cellulæ ethmoidales are thus clearly shown. 1, Probe through ostium frontale; *B.eth.*, bulla ethmoidalis; *Cel.eth.post.*, cellulæ ethmoidales posterior; 2, probe through ostium of most posterior ethmoidal cell; *S.sph.*, sinus sphenoidalis; *Hypoph.*, hypophysis; *C.supr.I*, concha suprema I; *C.sup.*, concha superior; *Ton.phar.*, tonsilla pharyngea; *Ost.tub.aud.*, ostium pharyngeum tubæ auditivæ; *C.inf.*, concha inferior; *C.med.*, concha media; *H.semi.*, hiatus semilunaris; *Proc.unc.*, processus uncinatus.

This section gives a clear view of the structures in the middle fossa normally hidden by the operculating middle turbinal.

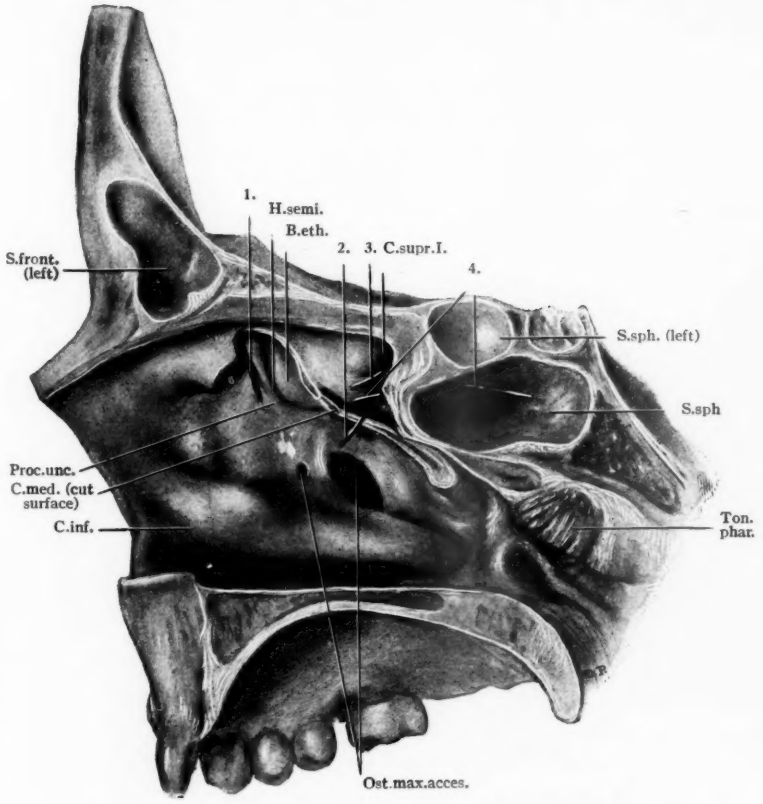


Fig. 478.—Specimen seventeen years old. Sagittal section 1 mm. to the left of the median line. The septum nasi and the anterior portion of the concha media have been removed. (Series D, No. 83.) Note the presence of two accessory ostia maxillaria. Similar ostia were found opening into the left sinus maxillaris of this case. Both sinus maxillares contained mucous cysts near the accessory ostia. 1, Probe in ostium frontale; 2 and 3, probes in the ostia of cellulæ ethmoidales posterior; 4, probe through ostium sphenoidale; *H.semi.*, hiatus semilunaris; *B.eth.*, bulla ethmoidalis; *C.supr.I*, concha suprema I; *S.sph.*, sinus sphenoidalis; *Ton.phar.*, tonsilla pharyngea; *Ost.max.acces.*, ostia maxillaria accessoria; *C.inf.*, concha inferior; *C.med.*, concha media, *Proc.unc.*, processus uncinatus; *S.front.*, sinus frontalis (medial portion of left sinus extending slightly to the right of median line).

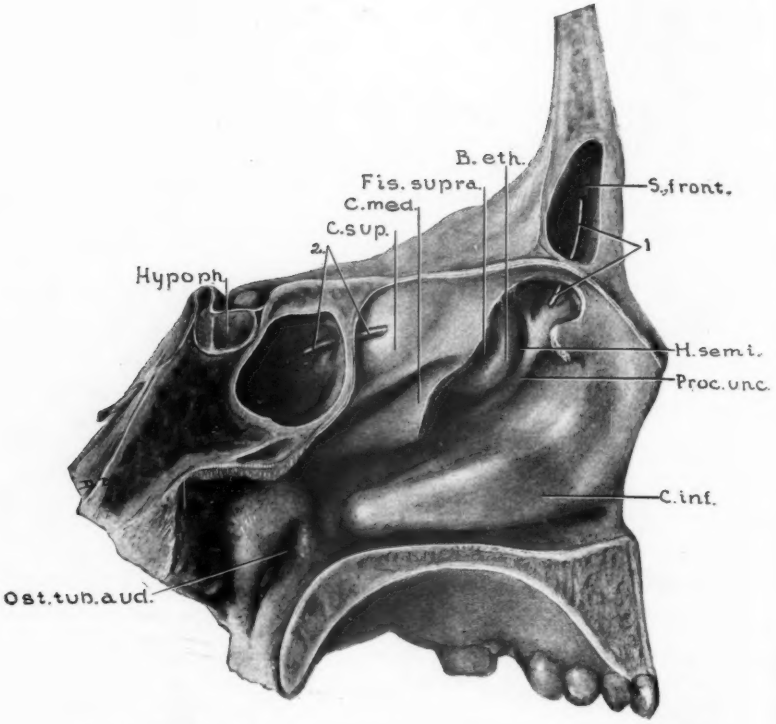


Fig. 479.—Specimen twenty-one years, six months, and twenty-nine days old. (Series D, No. 91.) Sagittal section, 1.5 mm. to the left of median line. Anterior portion of concha media has been removed to show the relations of structures forming the lateral nasal wall. 1, Probe through ostium frontale; 2, probe through ostium sphenoidale; *S.front.*, sinus frontalis; *H.semi.*, hiatus semilunaris; *Proc.unc.*, processus uncinatus; *C.inf.*, concha inferior; *Ost.tub.aud.*, ostium pharyngeum tubæ auditivæ; *Hypoph.*, hypophysis; *C.sup.*, concha superior; *C.med.*, concha media; *Fis.supra.*, fissura suprabullaris; *B.eth.*, bulla ethmoidalis.